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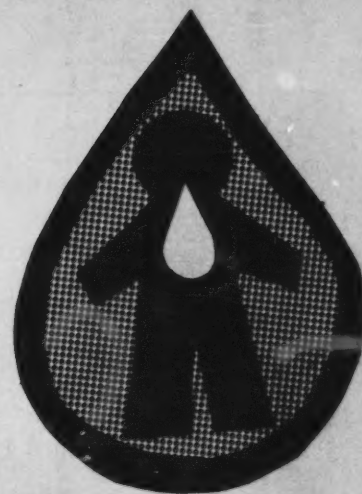
ABSTRACT

Presented is a set of 10 lessons on safe drinking water in Alaska for use by elementary school teachers. The aim is to provide students with an understanding of the sources of the water they drink, how drinking water can be made safe, and the health threat that unsafe water represents. Although this curriculum relates primarily to science, health, and social studies lessons, the follow-up activities also involve skills developed in art and English classes. Among the topics covered are the water cycle, microscopic organisms, water treatment, and pollution. Each lesson includes a materials list, vocabulary, questions, procedure, and recommendations for additional activities. Teacher resources are listed.

(Author/WB)

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SAFE DRINKING WATER FOR ALASKA



Curriculum for Grades 1-6

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**FOR THE
HEALTH OF
YOUR
FAMILY...**



**IS YOUR
DRINKING
WATER SAFE?**

This booklet was prepared by the
SOUTHEAST REGIONAL RESOURCE CENTER

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for the
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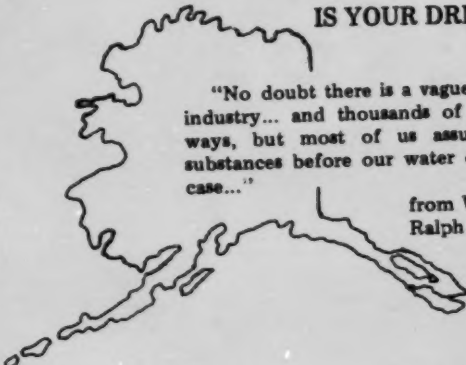
Jay S. Hammond
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Ernst W. Mueller
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Juneau

1979

IS YOUR DRINKING WATER SAFE?



"No doubt there is a vague awareness that toxic chemicals from industry... and thousands of other contaminants enter our waterways, but most of us assume that 'somebody' removes these substances before our water comes out of the tap. This is not the case..."

from Water Wasteland, a 1972 report of the Ralph Nader study group on water pollution.

From the rain forests of the Southeast to the semi-arid expanses of the northern slope, Alaska has abundant quantities of water. From region to region its uses vary—transportation, power generation, mining operations, and fish and wildlife habitats. The water we use to drink, however, is often taken for granted as safe.

Alaska has millions of acres of uninhabited wilderness where evidence of man's polluting influences are at the present time minimal. Alaskans have always lived very close to their natural resources. Many rely on water for their livelihoods and subsistence, so it is important that our waters be kept safe for all their many uses.

Alaska, at present is relatively undeveloped, but as our population grows and as our natural resources are explored and developed, the need increases to learn more about how we keep our waters safe. The quality of drinking water can vary greatly from community to community, and even house to house, depending on which sources are used. But there are also problems that are common to specific geographical regions. This booklet discusses contaminants and health hazards associated with Alaska's drinking waters, with particular attention to those which present regional problems. Where do you live, and is your drinking water safe?

Alaska encompasses a land area of 586,300 square miles, with a coastline of approximately 46,300 miles. Alaska has great rivers, huge lakes, large amounts of underground water, and areas of rain-forest precipitation. Glaciers supply streams and lakes with water frozen thousands of years ago.

Climatic factors influence both life forms and life-styles considerably and have a great impact on our water resources. Because of cold winters, little precipitation, and permafrost, vast areas of the state have little available water during much of the year. Other areas have either great precipitation, as in Southeast; or extensive groundwater resources, as in the Rural Interior. But problems both manmade and natural affect the quality of drinking water.

There can also be a shortage of water where the demands on a water source cannot be met. Much of Alaska's population and associated industrial activity are located close to our natural watersheds. Problems of wastes contaminating water supplies, overuse, or overdevelopment are major issues of concern.

Contaminated water supplies directly affect health. Many rivers and streams which are crystal clear give the false impression that the water is pure and safe to drink. The clarity of the water is not an indication of the presence or absence of bacteria. These water supplies may be contaminated by disease-causing organisms from improperly disposed human wastes, or waste from other animals. Spring flooding creates an additional problem to water supplies from contaminated wastes, sediment and other pollutants washing into the water source from overflow. Water may contain natural contaminants such as arsenic, nitrate, or mercury, which are also hazardous to your health.

Cloudiness, or turbidity, is considered a physical contaminant to drinking water. It is caused by minute particles which remain suspended in the water. Excessive turbidity may shield disease-causing organisms from removal by most treatment processes. Turbidity also makes water unappealing to many people.

Most of us assume that unless the water looks dirty or tastes bad, it is safe for drinking. However, oftentimes contaminants are not only colorless, but also odorless and tasteless. Without proper protection or treatment, contaminated water can cause chronic or acute illness.

Alaska is a vast land composed of diverse environmental areas. Some drinking water problems are common to specific areas, while others are found statewide. The prevalent threats to human health in Rural Southeast, Rural Interior, Rural Arctic Coast, and Urban areas are the focal point of the following discussion. It is important to know the facts about your area because the impact is on you and the health of your family.





Rural Southeast:

*Emergency order issued on Switzer Creek (July 24, 1974): 33 cases of salmonella were confirmed in Juneau, caused by the introduction of untreated wastes into residential (trailer court) water distribution system.

*Ketchikan laboratory studies disclose gulls in disease spread (April, 1954): Studies done by the Ketchikan Public Health Laboratory have connected sewage disposal, water supply and gulls in spreading salmonella disease-producing organisms from contaminated sources into public drinking water supplies.

Polluted water sources involving improper sewage disposal systems have been major factors in these outbreaks. In occurrences such as these contaminated drinking water was found to be the means of transmission. Harmful microorganisms from human and animal wastes, if present in water sources and not properly treated, can cause such waterborne diseases as giardiasis, salmonella, shigellosis, typhoid fever, infectious hepatitis, dysentery, and skin infections such as impetigo.

Rainwater collection is a common practice in Southeast where precipitation is usually high. Rainwater meets the needs of small water users where wells or other surface water sources are not feasible. Collected rain does not contain concentrations of minerals found in most groundwaters or dissolved minerals such as sulfur and iron, which often give water an objectional taste. There is no danger of contamination from human waste; however, bacterial contamination can occur from birds dropping waste on roofs where rainwater is collected. Roofing materials may also contain harmful chemicals which can get into the collected rainwater. Radioactive particles can also be washed from the air. Rainwater needs to be filtered and disinfected to be safe for drinking.

The high water tables and shallow soils with high bedrock common to Southeast present problems to the conventional on-lot sewage disposal systems of septic tanks with leach fields. The ground water in areas with high water tables can become contaminated when septic systems are flooded and proper biological breakdown cannot take place. In areas with shallow soils, the liquid wastes all too often surface and drain into streams. (Surface streams are used quite often as water supplies for one or more families.)

Unappealing color and turbidity in drinking water from surface sources are common in Southeast. They present health hazards if a) turbidity prevents adequate disinfection of disease-causing organisms, and b) when the displeasing appearance, tastes, or odors of the water make users go to another, less safe source of drinking water.

Iron is probably the most common drinking water problem in Southeast groundwater, though it is primarily an aesthetic problem.

Rural Interior:

*Restaurant near Tok Junction (August 20 - September 2, 1971): 112 cases of gastroenteritis were attributed to contaminated water at a roadside restaurant on the Alaska Highway between Tok Junction, Alaska and Whitehorse, Yukon Territory.

*Arsenic in waters of Ester Dome Area (February, 1976): At least 30 families were shown to be intoxicated with arsenic contamination from domestic well waters. The arsenic contaminated groundwater samples were all located on a mineralized belt extending in an arc from Ester Dome to Pedro Dome-Cleary Summit.

*From 1936-1951 in the areas of Kuskokwim River and Nushagak Bay, many outbreaks of typhoid and dysentery occurred. These outbreaks were attributed to summer fishing camps consisting of tents crowded together with no sewage facilities. Drinking water for both man and animals was collected at the most convenient pond or creek.

The Rural Interior regions of Alaska encompass a diversity of environments, and a great variety of water resources. Water supplies are generally the most convenient river, stream or lake. In areas where precipitation is high, rainwater is used. Wells are a source of water in areas away from river systems and where permafrost is not too deep. In general the Rural Interior has abundant water resources, however, many factors control the quality and quantity for drinking water.

Seasonal climate changes are the major limiting factor of these sources. During winter months, most surface waters freeze. In some areas, water can be drawn from below the ice, or the ice can be cut and hauled to be melted in the home. This decrease in water flow affects health in that sufficient quantities are necessary for personal hygiene.

Quality can be degraded during the spring runoff period from wastes seeping into surface or groundwater sources from snow melt. In some areas, this dramatic increase of surface waters causes flooding. Flood waters can further contaminate a water source from overflows washing over land where human or animal waste may be deposited.

Rainwater is another seasonal source of water. Precipitation is strongly influenced by the mountain ranges in this area. Most precipitation comes from the south and decreases as it moves northward through the Alaska Range, causing northern regions to be semi-arid. The western portion of the Rural Interior does receive abundant rainfall during part of the year, and uses it as a source of drinking water. (Advantages and disadvantages to rainwater collection are discussed in the section on Southeast.)

In many areas of the Interior there is an abundance of groundwater, but once again quality and quantity of these sources can vary. In locations away from river systems, the available groundwater is often restricted by permafrost. The presence of frozen ground necessitate deeper drilling for water. A well that passes through great thicknesses of permafrost often freezes up. Iron in drinking water can be common. In areas where shallow wells are feasible, water can be high in dissolved solids and contaminants which filter in from the surface. Some ground and surface water naturally contains varying amounts of chemicals which can adversely

affect human health. Some of the chemical contaminants and their related health hazards are as follows:

Arsenic—a natural contaminant which, when consumed over a long period of time, can cause skin irritations, changes in skin color, and gastrointestinal and neurological disturbances.

Nitrate—poses an immediate threat to infants under three months of age by producing an anemic condition commonly known as "baby blue."

Mercury—levels in water can occur naturally or can be caused by industrial and agricultural use. Mercury poisoning in large doses may be acute; or chronic when in low doses over a period of time.

Other chemicals in water such as iron and manganese although acceptable from a health standpoint, may be undesirable because of odor, appearance, or taste. Scientists are still exploring the exact long-term, low-level effects on human health by many of these chemical contaminants.



Rural Arctic Coast:

*Since 1922, in the Barrow area alone, there have been 47 cases with 4 fatalities from typhoid fever and 31 cases with 1 fatality of paratyphoid fever. All were attributed to contaminated water.

*In the 1948 outbreak of Bacillary dysentery in Cape Halkett in the Barrow area there were 105 cases with 1 death, over a 5 month period. The water from Barrow village came from a lake, and during winter months, the slopes draining into the lake were used as the disposal area for human wastes.

Due to climatic factors and geographical location, the Arctic Coastal Region of Alaska faces the most severe problems of limited usable water. The Brooks Range, which forms the southern border of the arctic area, removes most of the moisture as air masses move northward causing annual precipitation to be that of a desert—about 5 inches. Permafrost in this area is continuous and deep, aggravating problems of water availability. During winter months, extreme water shortages exist because surface waters freeze entirely, making them nearly impossible to use. Water availability problems in the Arctic region directly affect health and restrict economic growth.

The complexity of water quality problems is vast in an area where limited water supplies are a major issue. Difficulties in treating waste water pose the biggest threat to available water supplies. Spring flooding in many areas of this region can further contaminate water sources by washing over land where human or animal waste may be deposited. In coastal communities, saltwater penetration into groundwater has also limited the quality of drinkable water. Oil and gas or mining operations now or will present competition for water supplies and a potential for water quality degradation. Measures must be taken now to protect the quality of available water. Both water availability and quality have a direct impact on health in that adequate amounts of safe water are needed for consumption, personal, and household hygiene.

There is a great need for development of adequate water storage and treatment facilities, distribution systems and sewage disposal systems. In colder climates, the capacity of water to assimilate wastes is much lower. The temperature of these waters seldom rises above 10° to 20° C, which retards biological and chemical reactions that naturally break down some wastes. However, bacteria, viruses and other sources of disease cannot be so removed.

Only the sparse population of this area and relatively low quantities of contaminants have kept water quality and availability under control. As Alaska develops and population pressures on the environment increase, so will the need to develop adequate water related systems.



Urban:

*On November 16, 1971, a trailer court tenant in Anchorage telephoned local health authorities to complain that the water was "dirty and had a bad odor." Upon investigation, the sanitary engineer found what appeared to be gross sewage contamination in the well water supply. Raw sewage backed up through the drain from a "soft plug" obstructing the borough sewer and spilled over the casings into the wells. Further investigation revealed 89 of 114 persons exposed were ill. The shigellosis symptoms included nausea, vomiting, abdominal pain, fever and diarrhea.

*In 1950, there was a typhoid fever outbreak involving 17 children. This outbreak occurred in the congested area outside Anchorage city limits where the people were dependent on shallow wells for water and single-premise sewage disposal (generally cesspools or privies). The outbreak was found to be from water contamination.

Contaminated water supplies and improper sewage disposal have been major causes of outbreaks like these. In all instances, poor sanitation played an important role. The crowding of people in urban areas increases health hazards. Rapid growth without suitable planning and development of water-related facilities can impact public health considerably.

As population increases, so will the demands on water supplies to support associated industrial and economic growth. Water shortages can develop from over-allocations of water supplies. The projected water needs for the Anchorage area have already exceeded the present known supplies. The lake levels in this area have been lowered significantly due to heavy demands on groundwater sources. Urban areas and their associated economic growth are very dependent on the quality of water on a sustained basis.

Another danger to existing water sources in urban areas is the problem of urban runoff. Pollutants are carried into our water supplies from the discharging of storm water, snow removal, sedimentation from land-development activities, etc. Systems must be developed to deal with these overflows before permanent damage to our waters occur.



FOCUS: CLEAN WATER STANDARDS

The Department of Environmental Conservation has set standards for the level of contamination allowed in drinking water. Microbiological, chemical, physical, and radioactive contaminants are all known to adversely affect human health. Periodic sampling is the only way to tell if a source is supplying safe water. It is important to know whether your water exceeds the standards and what treatment will protect your health.

Microbiological Contaminants—There are a great number of these contaminants that can be present in a water source and oftentimes are difficult and expensive to detect. However, the presence of microorganisms called coliform bacteria, commonly found in human waste, is used as an indicator of bacterial contamination that may result in waterborne diseases.

Chemical Contaminants—Levels have been established in the Alaska Drinking Water Regulations for arsenic, barium, cadmium, chromium, fluoride, selenium, silver, and sodium. In addition, levels have been set for six organic chemicals found in pesticides.

Physical Contaminants—Cloudiness and color characteristics of water can indicate an unhealthy water source. Particles suspended in a water source can protect disease-causing organisms from disinfection and also interfere with tests for coliform bacteria.

Radioactive Contaminants—These may be either natural or man-made. Natural sources are sometimes in ground-water, while man-made radioactive contaminants may be present in small amounts in rainwater or surface waters. Although at present not a significant problem in Alaska, radioactive waters could accompany future development of the state.



SOURCE PROTECTION AND TREATMENT

The most basic method of insuring the safety of drinking water is to protect the water source. The watershed, from which ground and surface waters flow, must be kept as free as possible from sources of contamination.

To protect contamination of well water, wells must be properly constructed and kept at safe distances from contaminating sources. (Requirements for drilling and construction of wells can be found in Alaska's Safe Drinking Water Regulations.)

The quality of the water source generally will determine the treatment process required to provide safe drinking water. Some of the water treatment techniques commonly used in Alaska are as follows:

Chlorination—Currently most water utilities use chlorine for disinfection. The ability of chlorine to kill microorganisms is directly related to the chlorine concentration and contact time. In sufficient quantities and with adequate contact time, it will kill coliform bacteria and disease-causing organisms. It also reduces some of the bad tastes and odors.

Filtration—Filtration is used in many water systems, especially those using surface water as a method of treatment. Filtration can remove suspended particles, color, and helps reduce objectional tastes and odor. It can be effective in removing spores of organisms which are not killed by disinfection. Filtration combined with chlorination provides an adequate treatment for most water supplies.

Chemical Treatment Techniques—Community and city public water systems usually use treatments consisting of adding chemicals which condense most contaminants into "floc" in the water. This floc is then allowed to settle and then is filtered out, removing with it many of the objectionable odors or tastes. Properly operated, these systems provide pure and safe drinking water.

Safe drinking water is extremely important to the health of you and your family. So don't take your water for granted.... **BE CONCERNED!!!!!!!!!!!!!!**

For more information call your local city or borough environmental health authorities or contact your regional environmental supervisor of the Alaska Department of Environmental Conservation.

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EMERGENCY WATER PURIFICATION TREATMENTS

BOILING—Boil water for one minute. Bring to a full rolling boil, not simply steaming. If the water has a flat taste, pour back and forth between clean containers 2 to 3 times.

IODINE—treatment can be accomplished in a number of ways. There are several products now on the market which simplify this procedure. Whatever method is used, iodine treatment is an effective method of disinfection and very practical for travelers as well as for home use.

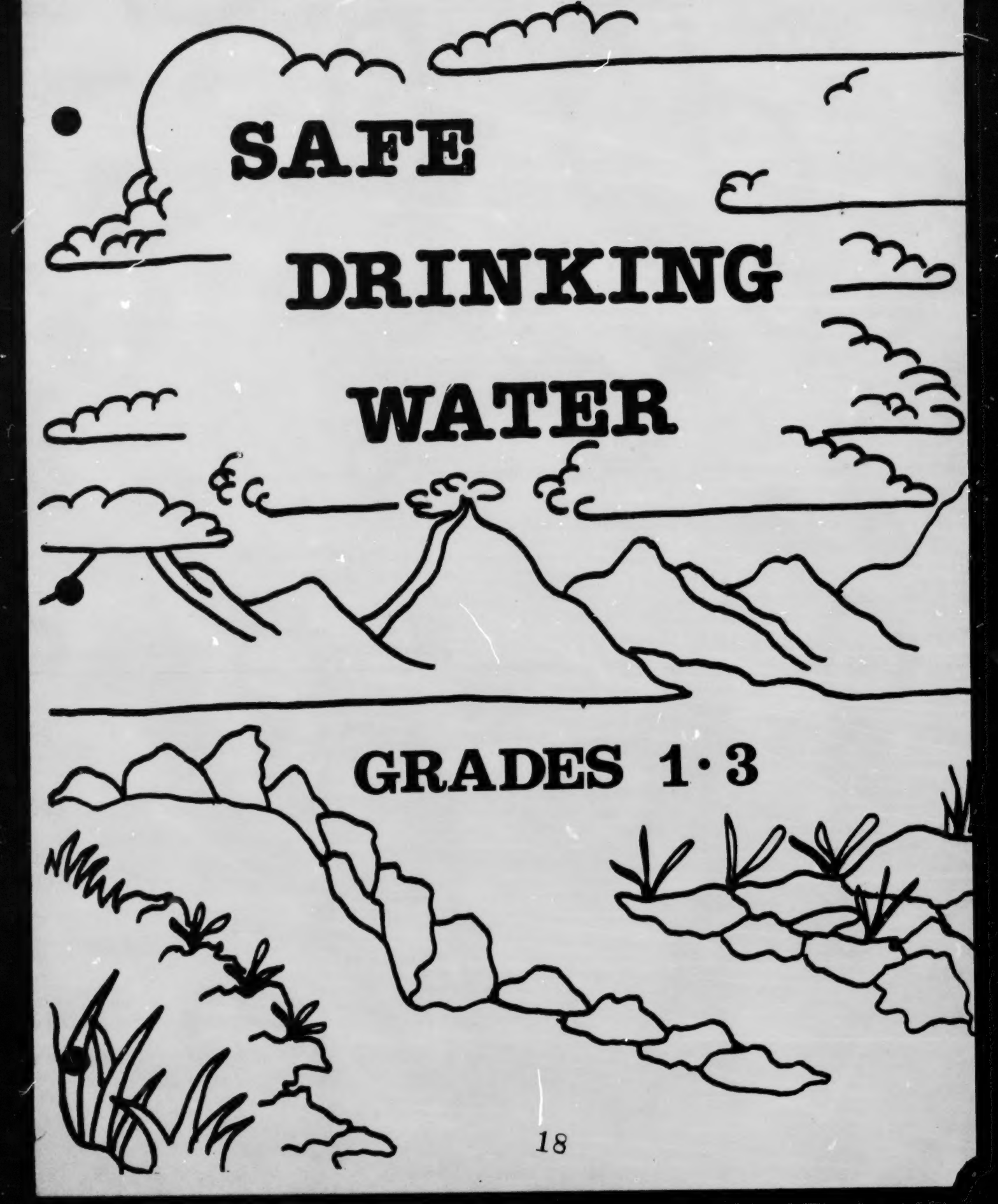
The following quantities are based on water temperatures being 37°F.

- 1) In a one-ounce clear glass bottle with a hard plastic cap, put 4-8 grams of U.S.P.-grade resublimed iodine—iodine crystals.
- 2) When water is to be treated, fill bottle with water and shake vigorously for 30-60 seconds. This will dissolve some of the iodine from the crystals. (*The concentration of the iodine solution depends on the water temperature. As water temperature increases, the amount of the solution used for disinfection decreases slightly.)
- 3) The iodine solution is used to disinfect water, not the crystals themselves. So it is important to let the crystals sink to the bottom before using. Carefully pour 1/2 ounce* of the iodine solution into each quart of water to be disinfected.
- 4) After adding iodine solution to the water, mix thoroughly and allow to stand 30 minutes before drinking.

When more disinfected water is needed, the above steps can be repeated until the iodine crystals in the bottle are used up. The shelf life is unlimited.

CHLORINATION—is the most commonly used method of disinfection of water and one usually recommended by public health authorities.

- 1) Add one drop of household bleach such as Clorox or Purex (containing 5.25% available chlorine) to each quart of water.
- 2) If the water is cloudy, add three drops of the solution to each quart of water.
- 2) After adding the chlorine solution to the water, mix thoroughly and allow to stand 30 minutes before drinking.



SAFE

DRINKING

WATER

GRADES 1-3



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Juneau, Alaska 99811

Jay S. Hammond
Governor
Juneau

Ernst W. Mueller
Commissioner
February 1980

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STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION

JAY S. HAMMOND, GOVERNOR

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January 29, 1980

Dear Alaskan Educator:

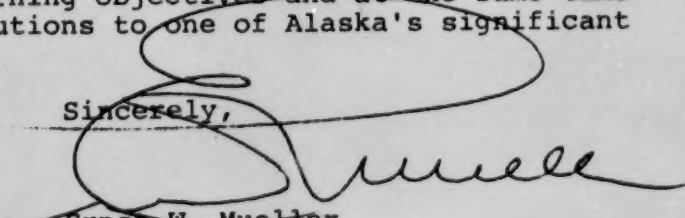
In a land of sparse population, abundant wildlife, clear waters and good fishing many Alaskans are lulled into thinking their drinking water is pure as the proverbial "driven snow." While there isn't a high degree of industrial pollution associated with urban development, Alaska does have very real health hazards. Localized pollution problems do exist, and often occur where they are most likely to present a threat to human health--in the communities where people live.

This curriculum material on safe drinking water in Alaska has been designed to provide students with a basic understanding of the sources of the water they drink, how drinking water can be made safe, and the health threat that unsafe water represents. The children to be presented with this unit are continuously exposed to health threats that may exist in their communities, and will one day, like their parents, have to pay the price for safe drinking water. This price is paid through user fees, treatment supply and distribution equipment, and water testing.

This curriculum is multi-disciplinary and can be approached from any of the following subject areas with little adaptation: health, science, social sciences, and government. The suggested activities include skills developed in art, English, drama, and library classes. This curriculum could be used very effectively when coordinated between classes taught in several subject areas.

We hope you find this material to be very useful in helping your students meet your own learning objectives and at the same time learn about causes and solutions to one of Alaska's significant environmental problems.

Sincerely,



Ernst W. Mueller
Commissioner

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Safe Drinking Water

Introduction:

The next five lessons teach two concepts: 1) water travels in complete cycles; 2) drinking water is susceptible to contamination. The lessons emphasize an overall familiarity with the water cycle rather than memorizing specific stages of the cycle.

The first two lessons introduce the idea that water is a limited resource which is continually reused and explores the origin of drinking water including how that supply is dependent on the water cycle. These units establish a basic understanding of the importance of pure, unpolluted water. Vocabulary can be kept to a minimum. The teacher may wish to substitute basic synonyms for the stages of the water cycle -- clouds for evaporation and vapor, rain for precipitation, etc. The reading is for oral reading by the teacher and lends itself to a show-and-tell presentation using a water cycle transparency.

Lesson three ties the problems of water pollution in with the water cycle and drinking water concepts. Introduced as pollution-caused health problems, are micro-organisms. Lessons four and five introduce treatment methods for handling the water pollution problem. Chlorination is introduced in the classroom as a method to purify water, and a trip to the local water treatment facility provides a concrete reference for the concepts of water pollution and safe drinking water.

Flexibility is a prime goal in the use of these lessons. The lessons may be taught in any order depending on the needs of the students and the availability of resources.

TEACHER RESOURCE LIST

The resources listed below can be found in the Alaska State Library system.

- Adler, Irving, The Environment, 1976 (J 574.5 ADLE)
- Borsoff, Norman, Don't Give Up, 1972 (J)
- Bova, Benjamin, The Seeds of Tomorrow, 1977 (J 301.3 BOVA)
- Brennan, Nicholas, Olaf's Incredible Machine, 1975 (J)
- Dwiggins, Don, Spaceship Earth; A Space Look at our Troubled Planet, 1970 (J 628.5 DWIG)
- Elliot, Sarah M., Our Dirty Land, 1976 (J 363.6 ELLI)
- George, Jean Craighead, Hook A Fish, Catch A Mountain, 1975 (J)
- George, Jean Craighead, Who Really Killed Cock Robin? An Ecological Mystery, 1971 (J)
- Gregor, Arthur S., Man's Mark on the Land, 1974 (J 301.31 GREG)
- Hoff, Sydney, Amy's Dinosaur, 1974 (J)
- Hyde, Margaret Oldroyd, For Pollution Fighters Only, 1971 (J 628.5 HYDE)
- McCoy, Joseph J., Shadows Over the Land, 1970 (J 628.5 MCCO)
- Meyer, Louis A., The Clean Air and Peaceful Contentment Dirigible Airline, 1972 (J)
- Peet, Bill, The Wump World, 1970 (J)
- Pomerantz, Charlotte, The Day They Parachuted Cats on Borneo: A Drama of Ecology, 1971 (J 574.509 POME)

Lesson I

The Water Cycle

Objective:

Students will be able to color a picture depicting the water cycle and indicate in written or oral form how water is reusable.



Materials:

Small pot
hot plate
8" x 10" or larger sheet of glass, metal (anything with a hard, non-porous surface)
2 pot holders
crayons
1 student response sheet:
 "Color the Water Cycle" (pg. 9)
1 reading material, "The Water Cycle" (pp. 6 - 8)

Introduction:

This unit will establish that water is reusable. The term "water cycle" is generally used with children when referring to this concept. The reading material which accompanies this unit is designed to present that concept to young children. Depending on the age and experiences of the group you are working with the information will have to be tailored to meet their needs.

Vocabulary Preparation:

cycle
continent
basin
evaporation

vapor
huddle
condensation
droplets

surface
moist
moisture
currents

Instructional Activities:

(lead-off question)

1. Pre-heat a pot of water to near boiling on the hot plate.
2. Show a world map/globe. Ask students, "What does the blue on the map mean?"
3. Ask, "When rain falls on us, where does it come from?"
4. Ask, "Where do the clouds come from?"
5. Tell the students that they will see how rain is formed.
6. Place the pot of hot water on the hot plate until the water begins to boil.
7. With the pot holders, put the piece of non-porous material (glass or plastic makes viewing

the condensation easier) over the pot to allow the steam to collect.

(follow-up questions)

8. As the droplets form, grow heavy, and fall, ask, "How many ways did we see the water? Was there a time when we could not see the water?"
9. Review material in "The Water Cycle", adapting to student level of understanding in reference to the demonstration.
10. Ask, "Can you make new water?" (No, all the earth's water is part of a water cycle, re-used in one form or other repeatedly.)
11. Show a glass of drinking water and ask, "Where does your water come from?" Lead the students through a possible cycle of the water based on the demonstration.

(student response)

12. Hand out the "Color the Water Cycle" response sheets and crayons and ask the students to color the parts of the water cycle.

Additional Activities:

1. Tell a story about a drop of water -- where it has been, who has used it and for what, what shapes it has taken. This could be done orally, through a drawing sequence, or in written form.
2. Be a water detective. On "I Spy" drawing paper, show as many forms of water (rain, dew, cloud, ice), uses for water (drinking, washing, transportation, cooking), and sources of water (ground, stream, air, tap, well) as the student-detective can identify. This can be shown in list or drawing form.
3. (Grade K-1) Create a choreographed water cycle, using children and simple props to act out rivers, oceans, clouds, raindrops and the progression of these through the water cycle.
4. Follow a small stream to its source and see where it originates. Ask students to point out plants, insects, and perhaps larger animals which depend on the stream for living space, food, protection, reproduction. You might explain these needs according to the level of understanding of your group. Where does this water come from? Who might use it further along?
5. Write a short poem (haiku style or other) about rain, dewdrops, fog, snow.

The Water Cycle

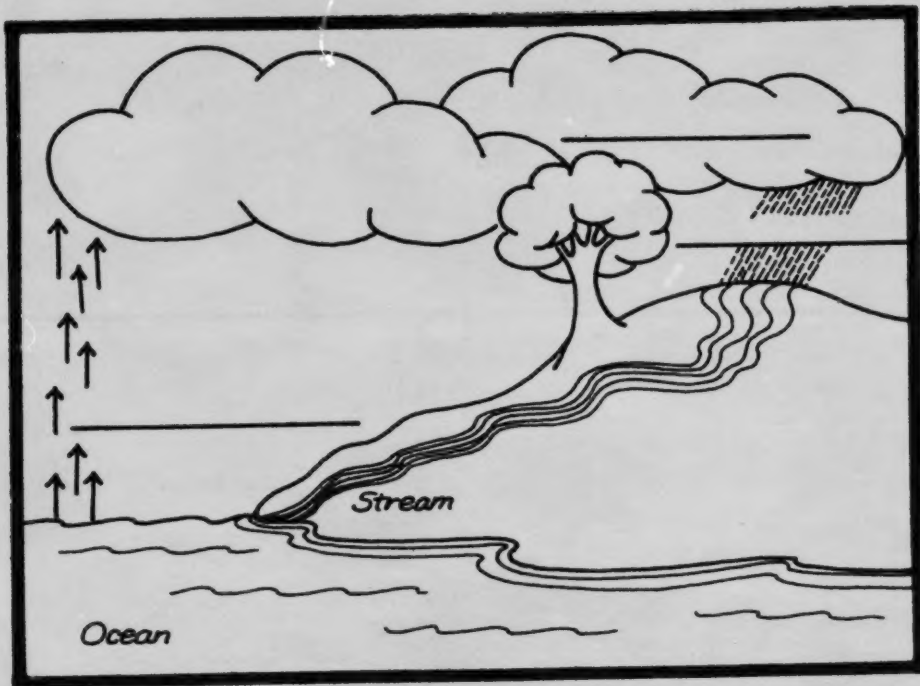
Have you ever noticed on maps of the world all the water areas covering the earth - oceans, lakes, rivers and streams? Water covers most of the earth. It appears in many places in many forms in a regular cycle.

To understand this cycle, let us imagine the oceans rolling in their great basins between the continents. The sun shines on the rather flat water surface and heats it. As the water grows hotter, some is bumped off into the air. These tiny bits of water in the air become like a small, warm, moist cloud. (This process is known as evaporation.)

Water as a vapor cannot be seen. When we see steam rising from a pan of hot water on a stove, we have actually seen water changed before our eyes from a liquid to a vapor and then back to a liquid again in the form of tiny little droplets. But we haven't seen the vapor. For as soon as the vapor has risen from the boiling water into the cooler air, the bits of water slow down and begin to huddle close together. The cooler air changes the vapor back into tiny little droplets. (This is called condensation.) We can change the tiny little steam droplets to larger droplets by suddenly placing a cold metal pan in the path of the steam and holding it there for a while.

The Water Cycle (con't)

The vapor from the oceans (or from other water surfaces) is warmed by the sun. As warm air always rises, the vapor rises, higher and higher, until it begins to cool in the high cooler air. The vapor then starts to change back into tiny droplets of moisture much as it did in the case of the hot water pan on the stove. But the droplets of moisture rising from the ocean cover a great area and are carried around by wind and air currents.



Eventually, a cloud is formed. As the cloud is carried into colder areas, the tiny little droplets, in turn, group together - sometimes in enormous amounts to form a single raindrop. With rain, the oceans are replenished and the cycle is completed.

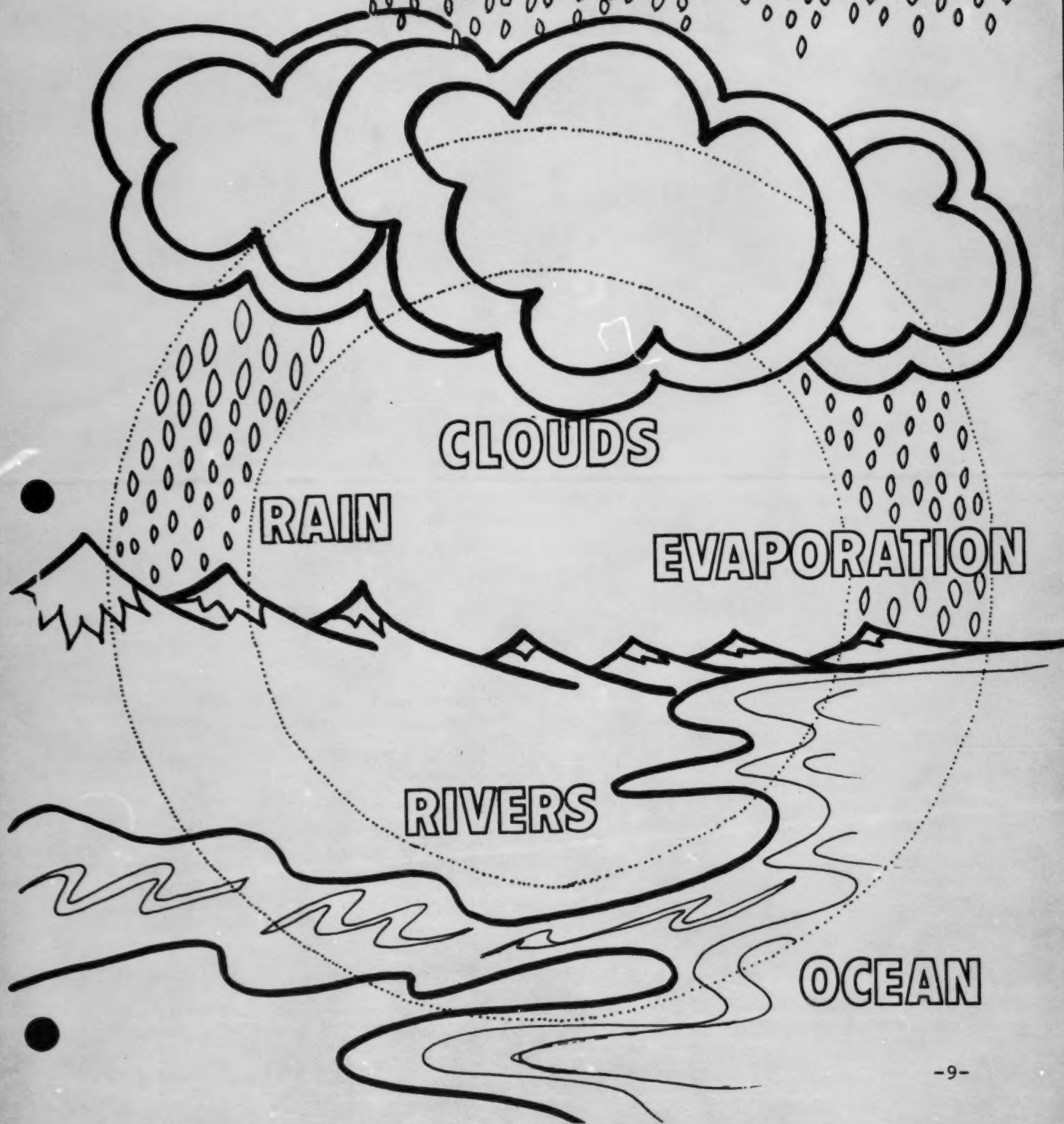
The Water Cycle (con't)

A cloud is a mass of tiny droplets which are too light-weight to fall through the air currents. When, by grouping together, the droplets reach a size large and heavy enough to fall without evaporating again before they hit the earth, they may fall as raindrops. In very cold upper air, the vapor closes together and becomes ice crystals, which fall as snowflakes.

In any event, raindrops leave their cloud and fall. In falling, they may take a shape as long and thin as a hot dog or as round and flat as a pancake. They may even be shaped like a dumbbell. Of course, not all the drops fall back into the ocean, for the clouds may have been carried many miles away by wind and air currents. Where the raindrops fall on the land, they may run together and course down mountainsides as streams. The streams become rivers that carve deeper and deeper river beds on their way to sea.

COLOR the

WATER CYCLE



Objective:

Students will be able to answer questions in written or oral form following a media presentation on the subject of safe drinking water, to the satisfaction of the teacher.

Materials:

3 Transparency Masters -
IIA, IIB, IIC (pp. 14-16)

5 Line drawings - #4, #5, #6, #7 & #8 (pp. 17-21)

The following list of films and books are obtainable from the Alaska State Library system in Juneau or Anchorage.

These suggested materials are designed for primary and lower elementary grade children. Each one presents a perspective on safe drinking water.

Films

14207 The Water We Drink -
Stresses the importance of developing proper drinking habits. Discuss sources of community water and methods of purifying it.

14028 Your Friend The Water - Clean or Dirty
An animated cartoon of a little boy who learns the factors behind a good supply of pure water, as well as the conditions which produce dirty, polluted water.

14209 A Visit To The Waterworks -
Provides an insight into the operation of an essential community service with emphasis on the importance of safe drinking water for the community's health.

14306 Water For The City -
Shows that water needed by people in a city begins as rain and snow that forms rivers, lakes and underground water basins. Depicts ways the water is purified and brought into homes in the city.

14307 Water - A First Film -
Discusses the role played by water in the processes of life. Shows that where there is little water the land is desert. Points out that water is used to drink, to cook, to water lawns and to fight fires.

14498 Adventures of Junior Raindrop -
Shows the need for everyone to be informed on good watershed management. Raindrops, like children, become delinquent and lawless. The animation is supplemented with live action scenes showing contrasting results of poor and good watershed management.

13048 Water Pollution -
Encourages student concern about the abuse of natural resources, tracing the causes and results of water pollution. Shows how clear water becomes contaminated and useless as garbage, sewage, insecticides and industrial wastes flow into rivers, lakes and streams. Points out that science alone cannot fight the battle against pollution.

Books

J/551.49/B561b Busy Water by Irma Black

J/551.49/Sm56f The First Book of Water by F.C. Smith

Introduction: This lesson should extend the concept of water cycle to the water used for drinking. Students should understand that the water they consume has a specific origin which is referred to as a water supply and that supply is dependent on the water cycle.

Water systems in Alaska vary greatly from region to region. Become familiar with the water system in your community. Refer to the community water system(s) in the course of the lesson. This series of lessons will culminate with a suggested trip to the local water treatment facility and/or water supply. The students should be prepared to apply this new information to a "real life" situation in their community.

Instructional

Activities:

1. Show transparencies IIA and IIB illustrating unhealthy water source environments. Ask the students to identify the source of pollution in each picture. For IIA, ask how the rubbish might have gotten into this water supply. For IIB, ask in what ways boats can pollute water sources. Ask for a show of hands of those who would drink from the water source shown in each transparency.
2. Explain to the group that they will now view a film showing how good water is important to people and must be from a clean, safe place. They should watch to learn where drinking water comes from and how it gets to their homes.

3. Screen the selected film. (If a film is not available, use line drawings 4,5,6,7,8, to explain where water comes from. Emphasize that water is in a use cycle and must come from a point where it may have other users.)
4. Picture 4 depicts four different types of water sources commonly found in Alaska. One other type common to the northern regions, cutting ice from frozen lakes, is not depicted here. Picture 5 shows five different ways in which water sources can become polluted. Chemical wastes is the least common in Alaska, but, nevertheless, exists as a threat in some areas of the state. Picture 6 shows how some communities in Alaska must obtain their drinking water. Not all communities are fortunate enough to have water piped into each home, nor do all communities have convenient sources of water, as depicted in picture 4. This shows why water pollution, even seemingly far from human populations, may eventually cause problems for safe drinking water. Picture 7 shows the relationship between the placement of a water supply source and of a human waste disposal system. Ask the students what would happen if the flow of water is reversed in this picture. How might that be dangerous? Picture 8 could be used to depict how water is distributed to individual houses through a system of underground pipes.
5. Discuss with the group the sources of water used in the community in which you live (lake, stream, dam, well, cistern, ice cutting, purification, desalination). Emphasize that none of the water sources are any better or worse than another. Explore which water supply sources require greater care to remain safe. (Show line drawing 4.)
6. Possible questions for discussion. Ask, "Do you know where your water comes from? How does it get to your house? What would happen if it did not rain this year? What would the water be like if someone dumped garbage in the water supply?"
7. Show transparency IIC illustrating an unhealthy water source environment. Ask the students to identify the pollution which threatens the safeness of this water supply. (It is consid-

(student
response)

ered unhealthy because of the decaying fish and animal contamination.) Discuss how the problem illustrated was created and what can be done about it. (There is a need to purify the water in some way. Ask the students if they can think of ways to purify drinking water.)

Additional
Activities:

1. Write a story about the life-giving qualities of water (begin with a title such as "Crashed In The Desert").
2. Make a drawing of an imaginative way to get water (Fish Power Water Pump). The drawing need not be practical or even possible. Discuss the schemes with emphasis on the difficulty of really making a safe, usable water supply.
3. Play "Howmuchisa". Have some standard size volume units available -- teaspoon, tablespoon, ounce, pint, liter, quart, gallon. Give students some odd-shaped containers of liquid to determine how much is actually contained in them by using the standard measurer. How much is in a glass of water, a can of pop, an ice cube, a snowball, etc.?

IIA



35¹⁴-

36

ПВ



37

38

II C



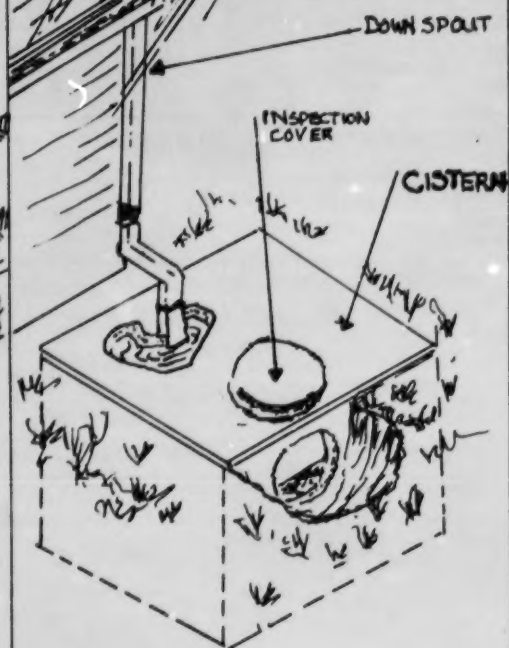
SPRING



41

CISTERN

(rain water collection)

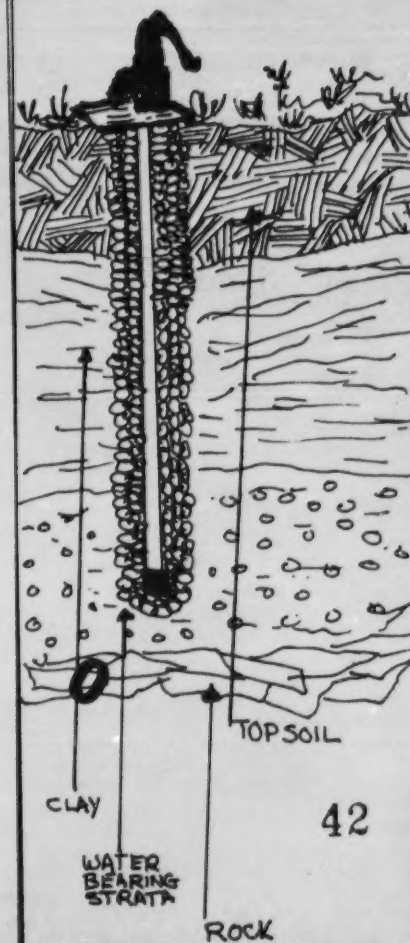


-17-

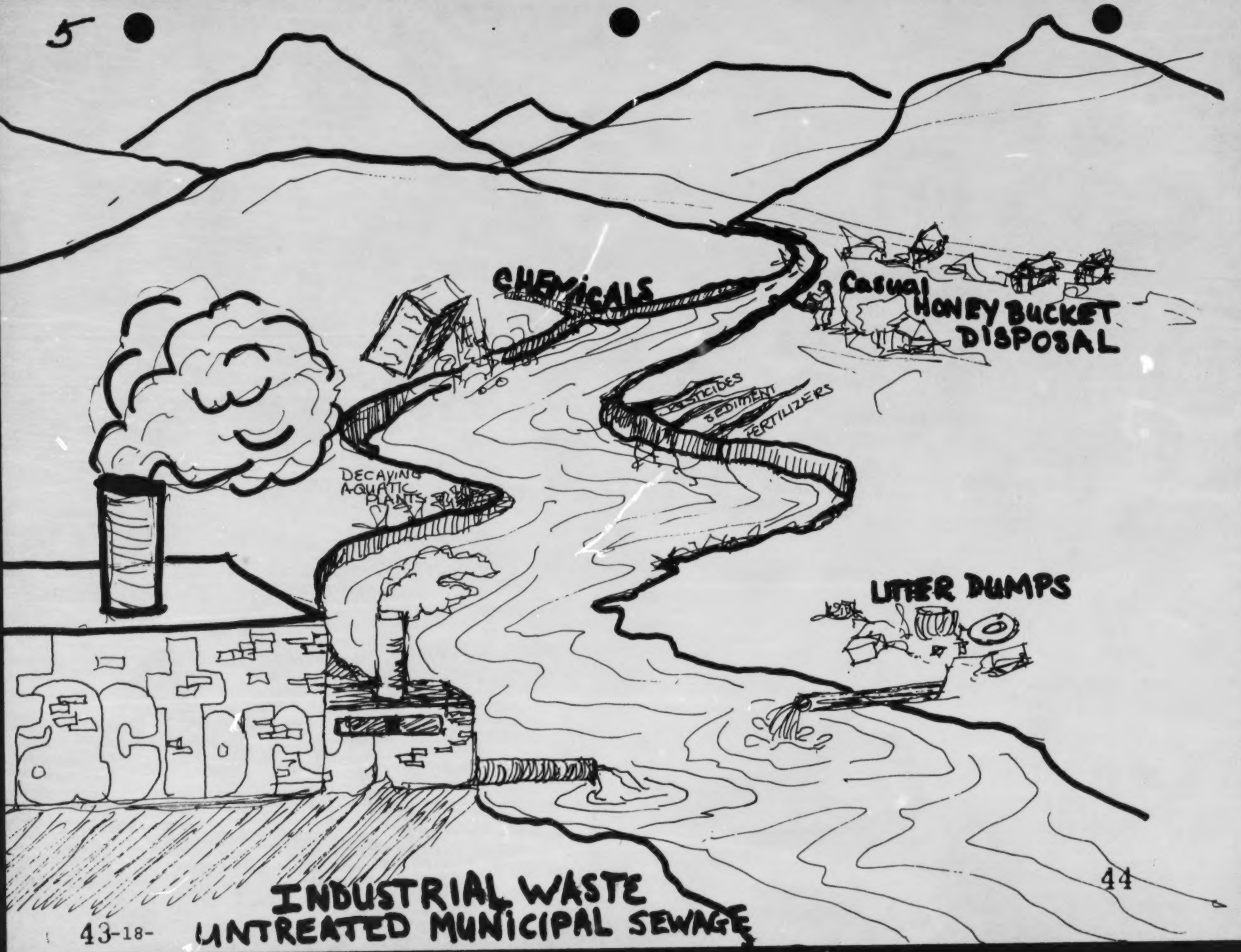
POND or STREAM



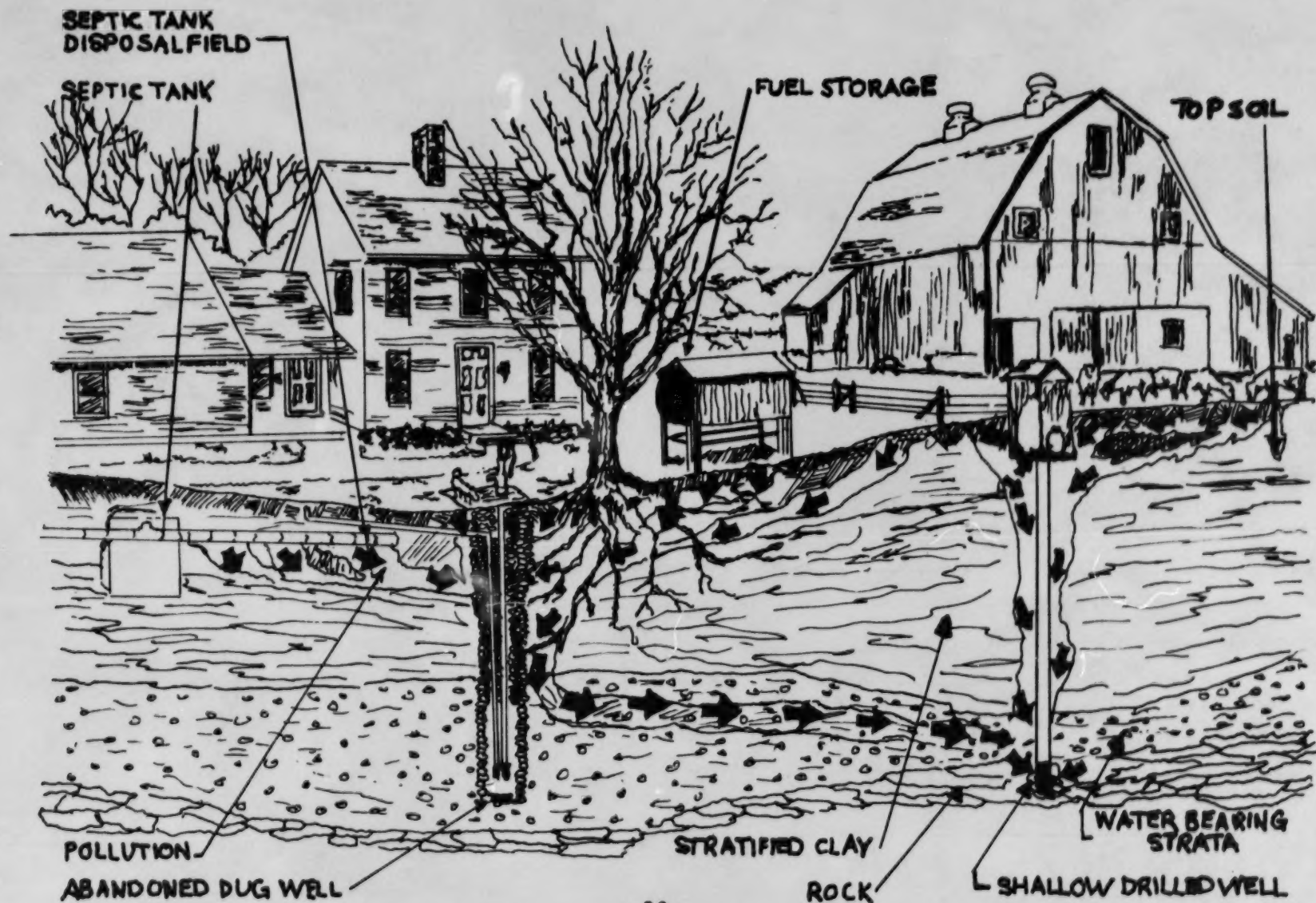
WELL

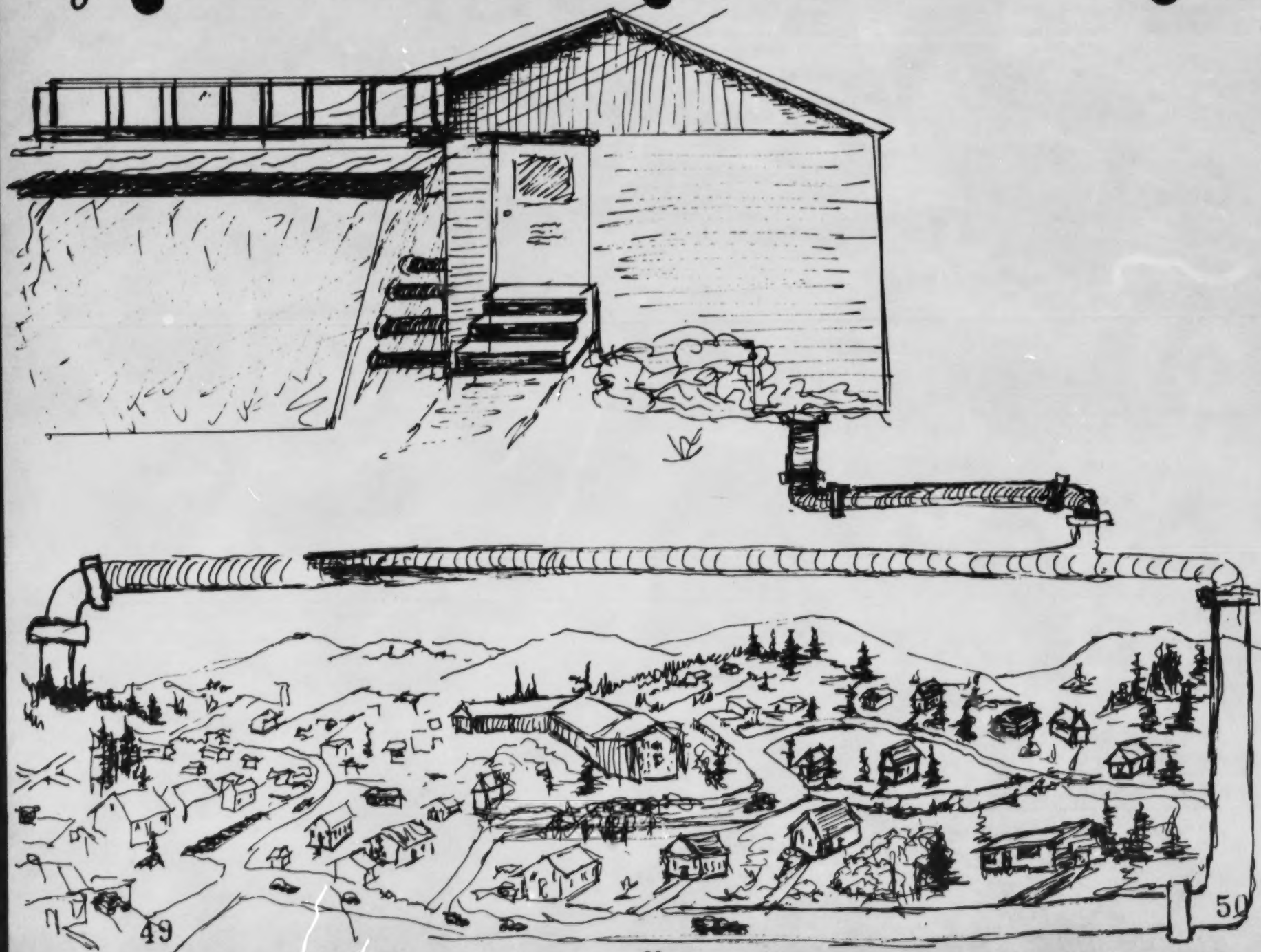


42









Lesson III

Microscopic Organisms

Objective:

Students will be able to explain in written or oral form, to the teacher's satisfaction, how small organisms can enter their bodies from polluted water sources.

Materials:

six small, peeled potatoes
boiled until soft
four-six sterilized pint
jars with lids (heat in
oven @400 about one hr.
to sterilize)

quantity of contaminated
(standing) water
(optional) other bacterial
sources - handkerchief,
unwashed hands, dirty
dish scrapings.

1 student response sheet:

"Do these plants and animals live in your
glass of water?" (pg. 24)

4 Transparency masters:

I, II, III, IV (pp. 25-28)

Introduction:

This lesson provides a concrete reference to the student's growing concept of pollution. Three categories of micro-organisms are responsible for several health problems. Some of the diseases which these micro-organisms can create are typhoid, cholera, dysentery, and diarrhea. The children are helped to understand and identify reasons why pollutants are dangerous and why water treatment facilities are needed.

Seeing is believing. An activity which enables children to observe bacteria can improve their understanding of these organisms and their environment. Activities involving the microscope can meet this need; however, these instruments are not often available to the elementary school teacher. A good alternative is the culturing of bacteria in colonies large enough to be seen without artificial aid.

Instructional Activities:

1. Discuss the concept of illness. Why do we get sick? Lead into the area of "germs" as disease agents. What are germs? Can we see them?
2. Tell the students that we can see germs two ways (1) with the help of a microscope which makes them appear larger, (2) by making them grow in number - a crowd of germs can be seen.
3. The bacteria culture demonstration can be



handled in one of two ways:

- A. Prepare the cultures several days in advance (minimum of three). Explain what you have done and have the students compare the resulting growth now and in a day or so.
- B. Prepare the cultures with the children and follow the growth for several days.

In either case one potato should be left uncontaminated for comparison. The others should be rubbed with several samples of contaminated water, standing water from outside, water used for hand washing (no soap), saliva, etc. Put lids on all jars, label, and place in a warm location not in direct sunlight. You might allow one contaminated jar to be exposed to sunlight (for use in Lesson 4). Do not let the children come into contact with the jar contents. Keep the lids in place throughout the experiment, and when it is completed dispose of the contents carefully.

4. Discuss the possible results of this type of growth in people. Why do we not always become ill immediately after contact with germs (they must grow in number)? Why do we not know immediately when we have run into a germ (they are very small when alone or few in number.)?
5. Ask the students if they would like to see some of the germs close up. Show transparencies produced from line drawings of micro-organisms. Optional: Allow students to view slides of micro-organisms through the microscope using prepared slides.
6. Hand out response sheets ("Do These Plants and Animals Live In Your Glass of Water?") Ask students to color in the drawings of the tiny life forms.
7. Ask the students to explain how small organisms (germs) get into their bodies and cause them to become sick.

Additional

Activities:

1. Draw "The Ugliest Germ". Tell where he is found and how to stay away from him.
2. Obtain microscopes and slides of bacteria, algae and protozoa from a local high school science department. Set up viewing stations so students can see real organisms.

DO THESE PLANTS AND ANIMALS LIVE IN YOUR GLASS OF WATER?

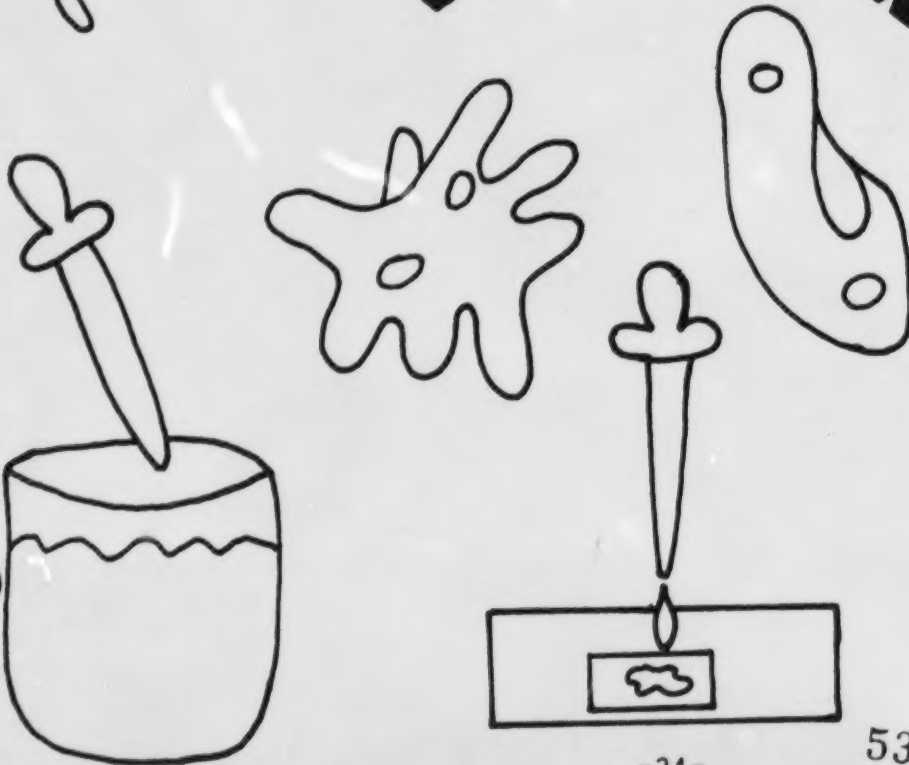
BACTERIA



ALGAE



PROTOZOA



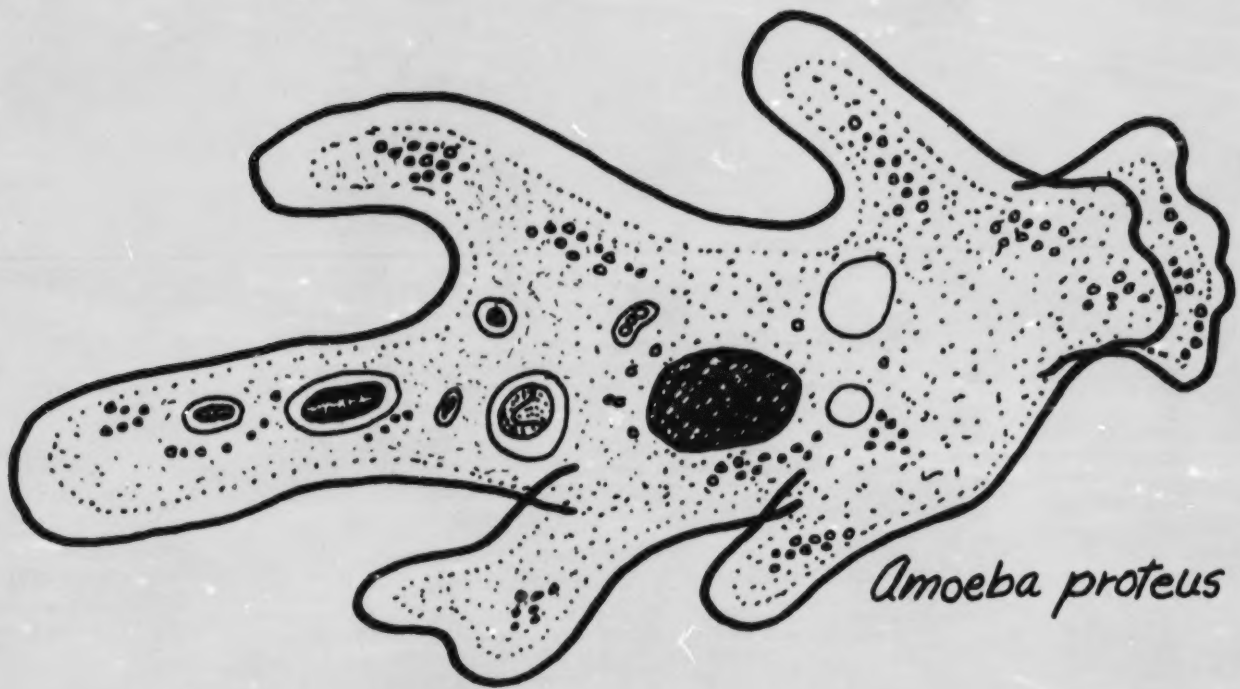
Protozoa



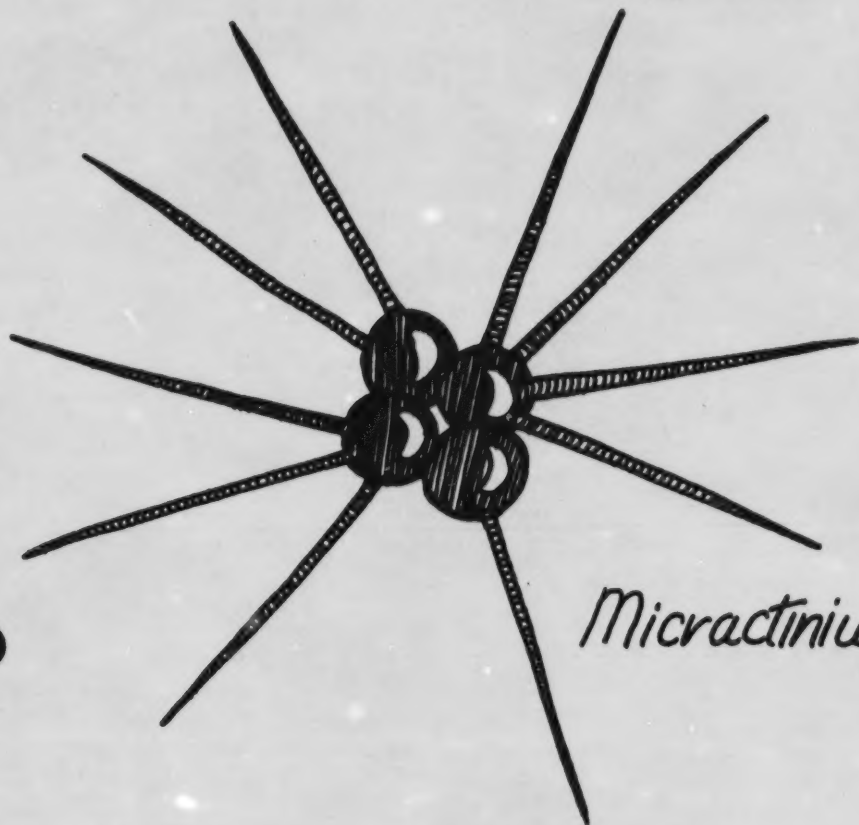
Giardia lamblia

I

Protozoa



Algae

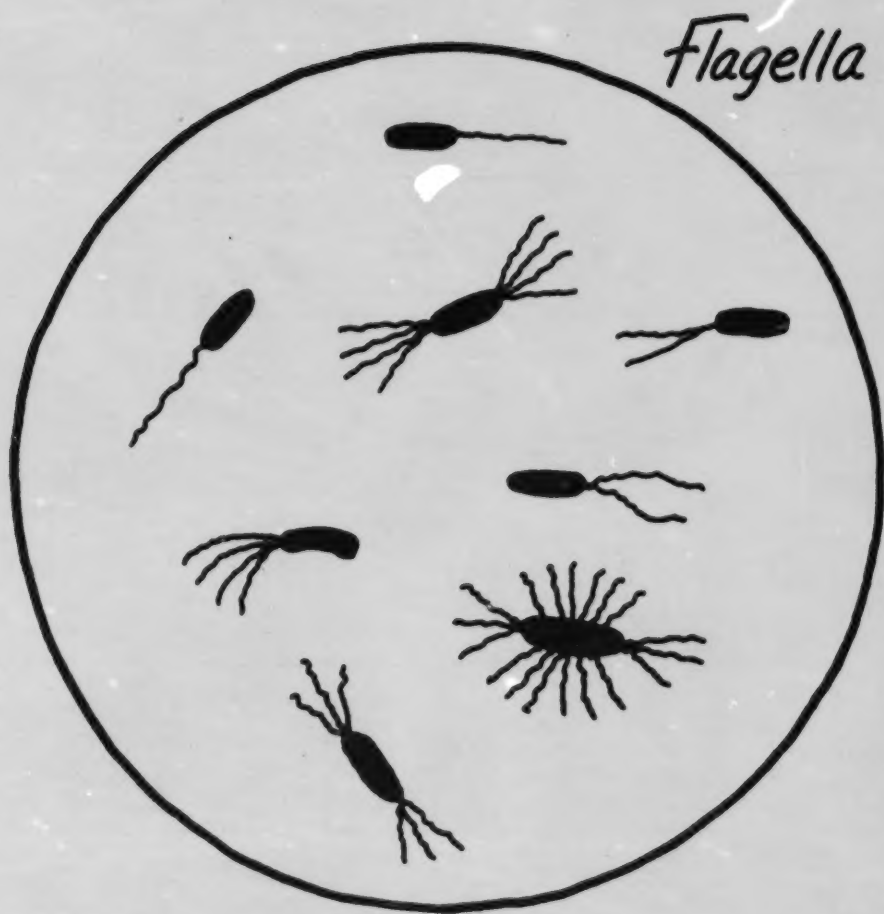


Micractinium



Euglena

Bacteria



Lesson IV

Chlorination Experiment

Objective:

Students will be able to describe at least one way in which water can be made safe for drinking following a demonstration of how chlorination protects drinking water.

Materials:

Warm water
2 clean glasses
packet of dried yeast
sugar syrup (Karo, etc)
laundry bleach (liquid - Chlorox, etc.) see note below*
stirring rod
1 student response sheet: "Find the Polluters - Color Them Brown" (pg. 32)



Introduction: If the water supply which your community is using is being treated, then chlorine is probably being added at a stage in that treatment. Chlorine has been used to destroy disease-causing micro-organisms in town water supply systems since 1897. It works by oxidizing (burning up by combining with oxygen) the organic matter in the water. This makes the water safer and changes the color, taste, and odor.

The experiment will show the effects of chlorine on micro-organisms. It will take approximately two hours to show clear results. The experiment can be started easily during a convenient point in the morning and then set aside for examination later in the day. This simple experiment will give the children a concrete reference for further learning about water treatment.

***IMPORTANT:** Do not allow the student to make an association between the chlorine used in the demonstration and chlorine bleach or its container. A possible result could be a child believing the bleach in itself is a good thing to drink - with disastrous consequences. Put the chlorine bleach in a vial marked with the poison (ECCH) symbols and warn the students that only when used in very small amounts can the chlorine kill germs without hurting people.

Instructional Activities:

(review)

1. Ask the children how they would suggest getting rid of the micro-organisms (super-small plants and animals) which they saw in the previous lesson. Why did the sample left in the sun-

light in Lesson III not multiply as greatly as the others? (There will likely be some imaginative responses - burn them, poison them, use a ray gun, etc. - which will lead into the demonstration.)

(new
activity)

2. Tell the class there is a way to kill the bacteria, algae, and protozoa which we've seen in the last lesson. Why is it important to kill the "germs" in water? (To prevent sickness). Say that we are going to grow an organism which cannot hurt us, unlike those grown in the last lesson which could if they were not sealed in jars.
3. If continuity of time is required prepare ahead: 1/2 teaspoon of dried yeast poured into 1/2 glass of warm water. Allow a half hour for the yeast to multiply. Separate the mixture into two clean glasses.
4. Show the students that the yeast is growing like the germs of the earlier demonstration - only much faster, before our eyes.

To one glass add five drops of the bleach. To each glass add one teaspoon of syrup and stir gently. Mark one "chlorine treated". Set aside for later examination. (A period of at least an hour should be allowed for the chlorine to take effect.)

5. To begin the afternoon period, ask the students how a water supply becomes polluted. Make a list of pollution sources on the chalkboard. Help the students recognize any identifiable threats to their water source.
6. Pass out the student response sheet. Allow the students to find the sources of pollution themselves and color them brown.
7. Show the class the results of the experiment. (The glass to which the chlorine was added should show no activity while the glass free of chlorine should show activity caused by the growing yeast.)
8. Yeast is a different type of organism than bacteria, protozoa, or algae which are associated with illnesses from polluted water sources. Make this distinction so that the students do not confuse the yeast which makes bread with organisms that cause illness and disease.

Lesson IV

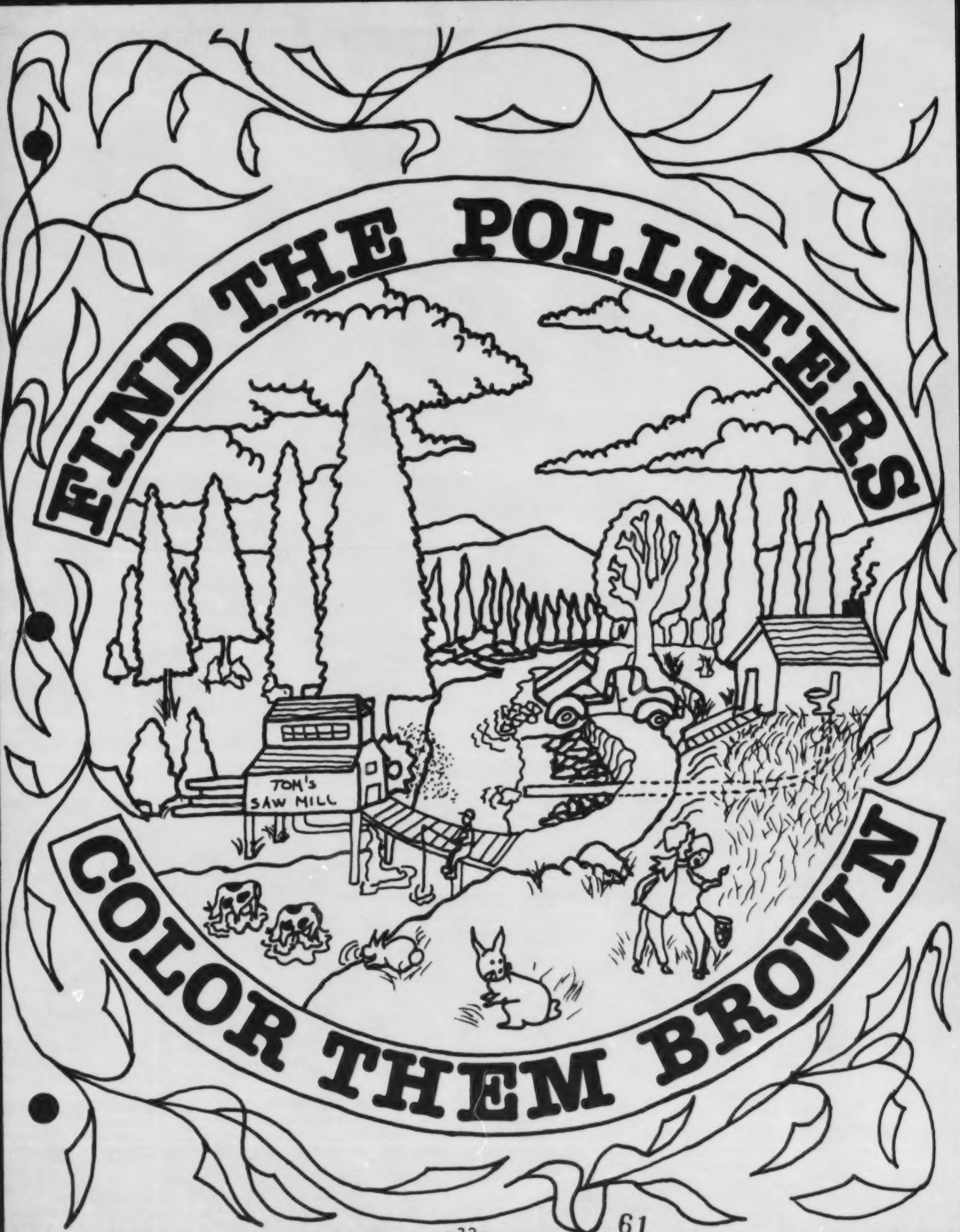
Chlorination Experiment (con't)

(student
response)

9. Ask the students to explain how the chlorine affected the yeast growth.

Additional
Activities:

Using the "Polluters" worksheet as a starting point have the class develop a list of pollution sources. Which can be prevented by people being more careful?



Lesson V

Water Treatment Facilities

Objective:

Students will demonstrate a basic understanding of water treatment by completing a worksheet based on a class visit to a water facility.

Materials:

Visiting arrangements and transportation to local water treatment facility.
1 student response sheet: "Water Treatment" worksheet (pg. 35)
Scissors, crayons



Introduction:

This lesson provides a setting to create a concrete reference for all of the concepts of water pollution which have been introduced. The children should be prepared before you visit the water treatment facility by reviewing these concepts:

- water cycle (all water is re-used)
- pollution sources
- micro-organisms (water-borne contaminants)
- treatment

The "Water Treatment" worksheet can be used to provide a focus for that review.

A site visit to a conventional filtration/chlorination plant should be no problem in the larger communities.

Smaller communities may have a simple pumping station and storage facility without elaborate treatment. Point out that if the water is clean and unpolluted to begin with, the important thing is to keep it clean en route to the users' homes. This is especially true of villages which distribute water by tank truck or block ice.

In some villages, the school water system itself will be the best example of good water treatment. A look at the school's waste water treatment system (gray/black water, bio-pure, or whatever) will reinforce the concept of the water cycle and the need for care and/or treatment of potable water.

Lesson V

Water Treatment Facilities (con't)

Prior to the actual visit, talk to the supervisor of the water facility to determine what the children will see and what the guide will emphasize on the tour. Ensure that the presentation will be within the groups level of understanding and attention span, and consistent with the lesson objective.

Instructional Activities:

1. Review the concepts of water cycle, pollution, "germs" (micro-organisms), treatment. The class may demonstrate an understanding of how these concepts affect their lives through the water which they drink.
2. Take a field trip to observe a water treatment facility.
3. Pass out the "Water Treatment" worksheets and discuss what a water treatment facility does to make the water safe for drinking. Mention that it is in the treatment plant that the water is made safer by adding heat and chlorine or by being filtered.

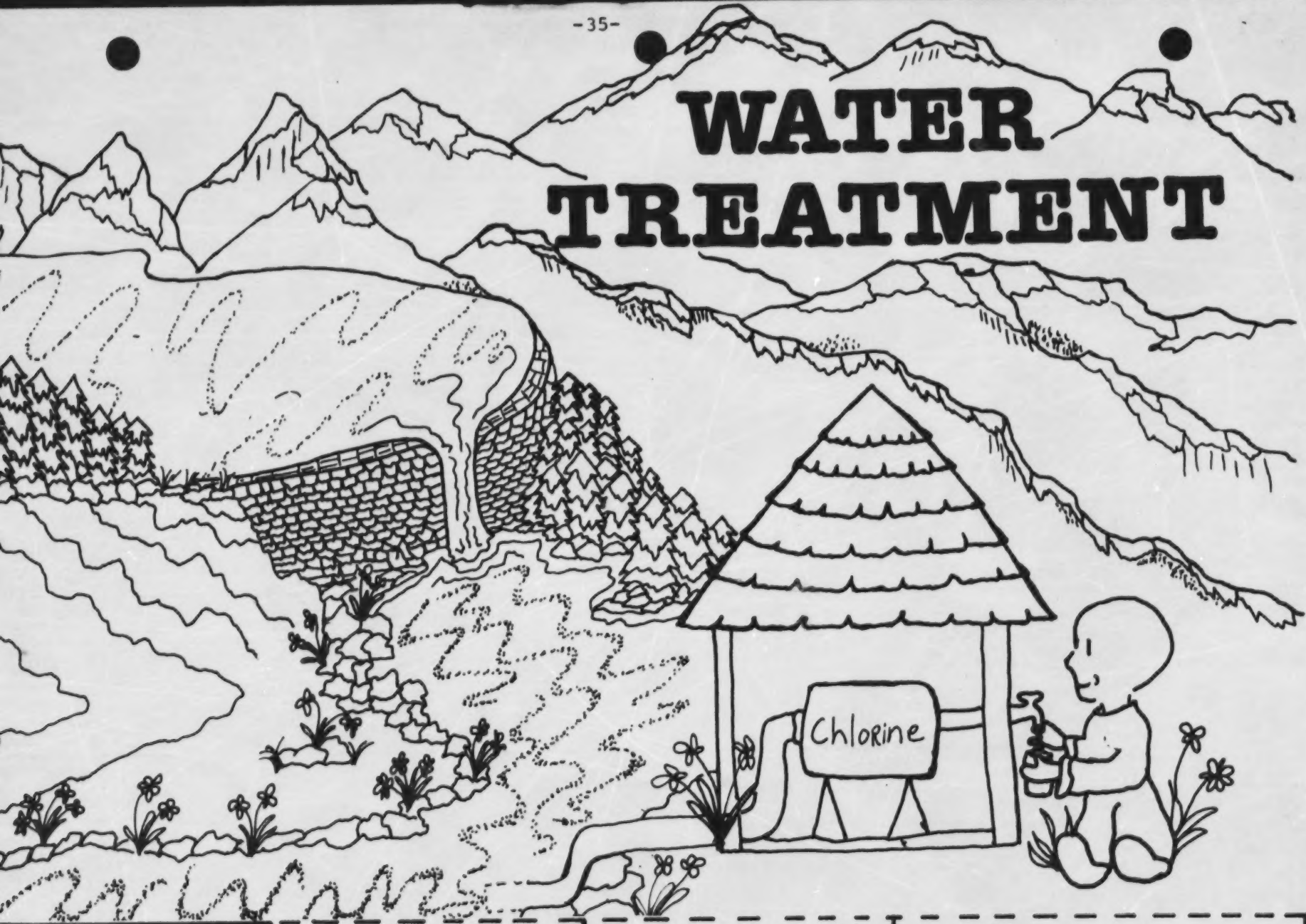
Ask the students to cut out the micro-organisms and glue them onto the worksheet in a spot appropriate to show their effect on water (before the "chlorine" stage), then color the picture. Display the pictures on a wall.

Additional

Activities:

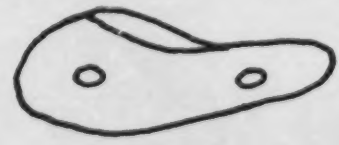
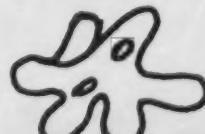
1. Play "The Clean Machine". The class creates a skit based on a town with dirty water where the people help make it clean. Each child contributes a cleanup or preventive act to add to the story line - each doing something to clean up the water.
2. A "Thank You" note(s) or drawing(s) to the water plant person.

WATER TREATMENT

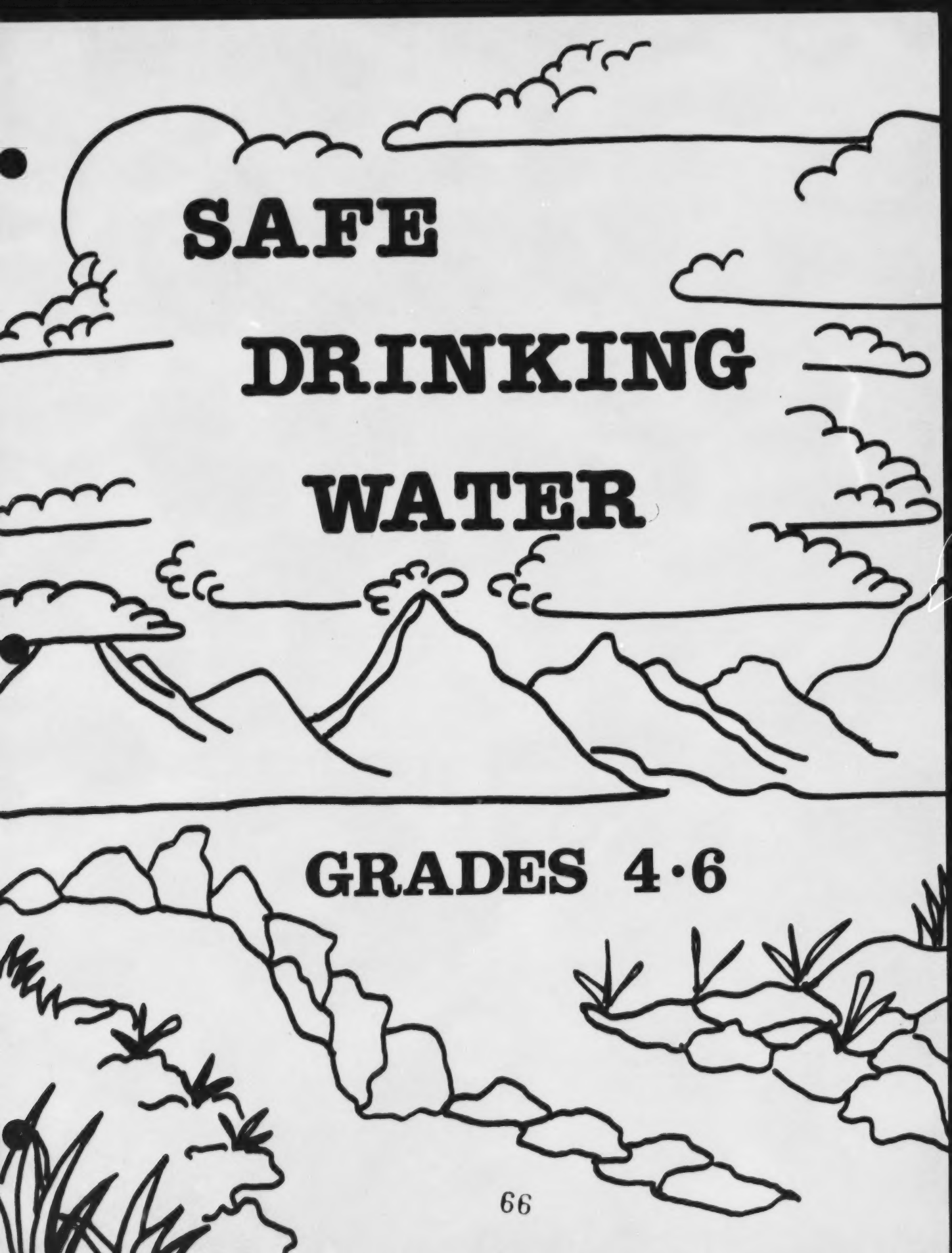


Microorganism:

64



65



SAFE

DRINKING

WATER

GRADES 4•6

STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION

JAY S. HAMMOND, GOVERNOR

POUCH 8 - JUNEAU 90811

January 29, 1980

Dear Alaskan Educator:

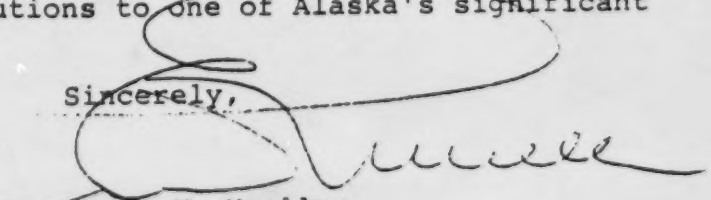
In a land of sparse population, abundant wildlife, clear waters and good fishing many Alaskans are lulled into thinking their drinking water is pure as the proverbial "driven snow." While there isn't a high degree of industrial pollution associated with urban development, Alaska does have very real health hazards. Localized pollution problems do exist, and often occur where they are most likely to present a threat to human health--in the communities where people live.

This curriculum material on safe drinking water in Alaska has been designed to provide students with a basic understanding of the sources of the water they drink, how drinking water can be made safe, and the health threat that unsafe water represents. The children to be presented with this unit are continuously exposed to health threats that may exist in their communities, and will one day, like their parents, have to pay the price for safe drinking water. This price is paid through user fees, treatment supply and distribution equipment, and water testing.

This curriculum is multi-disciplinary and can be approached from any of the following subject areas with little adaptation: health, science, social sciences, and government. The suggested activities include skills developed in art, English, drama, and library classes. This curriculum could be used very effectively when coordinated between classes taught in several subject areas.

We hope you find this material to be very useful in helping your students meet your own learning objectives ~~and at the same time~~ learn about causes and solutions to one of Alaska's significant environmental problems.

Sincerely,



Ernst W. Mueller
Commissioner

Offices of the

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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Wasilla AK 99687
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Ketchikan Field Office
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Ketchikan, AK 99901
225-6200

Soldotna Field Office
P.O. Box 1207
Soldotna, AK 99669
262-5210

Sitka Field Office
P.O. Box 540
Sitka, AK 99835
(132 Lincoln)
747-8614

Northern Regional Office
P.O. Box 1601
Fairbanks, AK 99707
(675 7th Avenue)
452-1714

Southcentral Regional Office
338 Denali Street, Rm 1206
MacKay Building
Anchorage, Alaska 99501
274-5527

Valdez Field Office
P.O. Drawer 1709
Valdez, AK 99686
835-4698

Safe Drinking Water

Introduction:

The following set of five instructional units has been developed to teach upper elementary-aged children about the possible health hazards of drinking water from polluted sources. Students of this age very likely have heard the term pollution and may even have developed a concept of water pollution. These lessons are intended to provide both a background in the relationship of pollutants to health and a concern for the quality of drinking water.

The first unit uses a review of the Water Cycle to establish the idea that water is a limited resource which is continually recycled. Explored is the origin of drinking water, including how that supply is dependent on the water cycle. The second unit follows up with a mediated introduction to water pollution. Provided is an overview, to help the students understand the major aspects of water pollution and its effect on human life. In the third unit micro-organisms are introduced as a real source of pollution-caused health problems in Alaska. Unprotected and untreated surface water, vulnerable to unpredictable contamination by man or animals, is recognized as a major part of the problem. Unit four demonstrates chlorination as a water purifier by showing the effect of chlorine on micro-organisms. The fifth unit, a reinforcement activity, is a field trip to the local water treatment facility to provide a concrete reference for the concepts of water pollution and safe drinking water.

Flexibility was a prime concern in the development of these lessons. Each teacher, keeping in mind the special needs of his/her class and the particular resources of the area, should feel free to adapt the materials and/or sequence of these lessons.

TEACHER RESOURCE LIST

The resources listed below can be found in the Alaska State Library system.

- Adler, Irving, The Environment, 1976 (J 574.5 ADLE)
- Borsoff, Norman, Don't Give Up, 1972 (J)
- Bova, Benjamin, The Seeds of Tomorrow, 1977 (J 301.3 BOVA)
- Brennan, Nicholas, Olaf's Incredible Machine, 1975 (J)
- Dwiggins, Don, Spaceship Earth; A Space Look at our Troubled Planet, 1970 (J 628.5 DWIG)
- Elliot, Sarah M., Our Dirty Land, 1976 (J 363.6 ELLI)
- George, Jean Craighead, Hook A Fish, Catch A Mountain, 1975 (J)
- George, Jean Craighead, Who Really Killed Cock Robin? An Ecological Mystery, 1971 (J)
- Gregor, Arthur S., Man's Mark on the Land, 1974 (J 301.31 GREG)
- Hoff, Sydney, Amy's Dinosaur, 1974 (J)
- Hyde, Margaret Oldroyd, For Pollution Fighters Only, 1971 (J 628.5 HYDE)
- McCoy, Joseph J., Shadows Over the Land, 1970 (J 628.5 MCCO)
- Meyer, Louis A., The Clean Air and Peaceful Contentment Dirigible Airline, 1972 (J)
- Peet, Bill, The Wump World, 1970 (J)
- Pomerantz, Charlotte, The Day They Parachuted Cats on Borneo: A Drama of Ecology, 1971 (J 574.509 POME)

Lesson I

The Water Cycle

Objective:

Students will view a demonstration of the water cycle and demonstrate their understanding of the concept by answering a series of questions.

Materials:

small pot
hot plate
8" x 10", or larger, sheet
of glass, metal
(a hard non-porous surface,
Glass or acrylic make viewing easier)

2 pot holders

1 student reading material: "The Water Cycle"
(pp. 42-43)

1 student response sheet, "Water Cycle Questions"
(pg. 44)

Introduction: Assess the class as to their understanding of the water cycle and its components - evaporation, condensation, precipitation. Many may understand that water is a limited resource which we must care for by conservation measures. If so, the demonstration might provide a good review. The students, as reinforcement, might be given a writing assignment using the above key words. The intent of this unit is to establish where water comes from as well as where we stand in the cycle as users.

Vocabulary

Preparation:	molecules	vapor	condensation
	evaporation	atmosphere	

Instructional Activities:

1. Ask the class these survey and motivation questions to assess what they already know and to generate interest in the lesson:
 - A. Where does water come from?
 - B. How can we make more water?
 - C. Where does the water you use at home come from?
2. Tell the students you are about to make it rain to demonstrate that rain is one part of a cycle of water use. While preparing the demonstration you might ask what a cycle is (answers will refer to motorcycle or bicycle - use the idea of a wheel going round and round to reinforce concepts of a cycle in nature).



3. Preheat a pot of water to near boiling on the hot plate (demonstration goes faster if you begin with hot water).
4. Have a student hold the flat piece of non-porous material over the pot to allow the water vapor to condense and collect. As the droplets form, grow heavy, and fall, ask whether new water has been made.
5. Using this visual model, discuss the water cycle. Emphasize that we, as water users, are part of this cycle.
6. Preview "The Water Cycle" reading by asking how small is the smallest piece of something - water, air. Lead into the concept of the molecule as the smallest unit of a substance. Emphasize that a molecule is very small indeed - too small to be seen by even a microscope.
7. Pass out "The Water Cycle" handout. This may be employed in a variety of ways, including :
 - (1) as an individual or group reading;
 - (2) as a guided reading using "Water Cycle Questions" as a guide sheet;
 - (3) as an information sheet for the teacher to use in preparation for class lecture/demonstration.
8. Hand out "Water Cycle Questions" for a review.

The Water Cycle

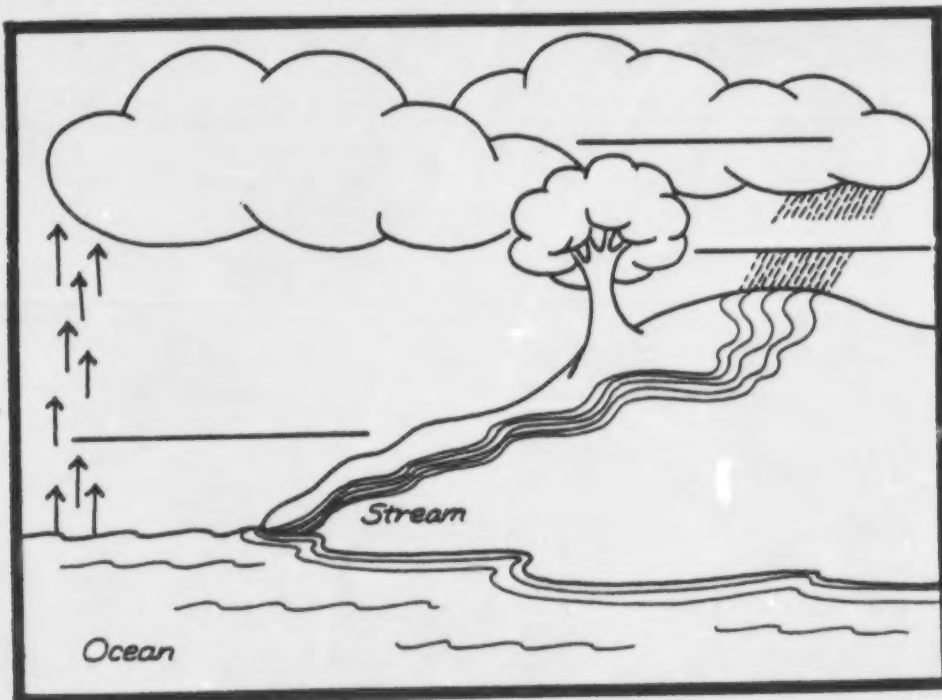
Have you ever noticed on maps of the world all the water areas covering the earth - oceans, lakes, rivers and streams? Water covers most of the earth. It appears in many places in many forms in a regular cycle.

To understand this cycle, let us imagine the oceans rolling in their great basins between the continents. The sun shines on the rather flat water surface and heats it. As the water grows hotter, some is bumped off into the air. These tiny bits of water in the air become like a small, warm, moist cloud. (This process is known as evaporation.)

Water as a vapor cannot be seen. When we see steam rising from a pan of hot water on a stove, we have actually seen water changed before our eyes from a liquid to a vapor and then back to a liquid again in the form of tiny little droplets. But we haven't seen the vapor. For as soon as the vapor has risen from the boiling water into the cooler air, the bits of water slow down and begin to huddle close together. The cooler air changes the vapor back into tiny 'little droplets. (This is called condensation.) We can change the tiny little steam droplets to larger droplets by suddenly placing a cold metal pan in the path of the steam and holding it there for a while.

The Water Cycle (con't)

The vapor from the oceans (or from other water surfaces) is warmed by the sun. As warm air always rises, the vapor rises, higher and higher, until it begins to cool in the high cooler air. The vapor then starts to change back into tiny droplets of moisture much as it did in the case of the hot water pan on the stove. But the droplets of moisture rising from the ocean cover a great area and are carried around by wind and air currents.



Eventually, a cloud is formed. As the cloud is carried into colder areas, the tiny little droplets, in turn, group together - sometimes in enormous amounts to form a single raindrop. With rain, the oceans are replenished and the cycle is completed.

The Water Cycle (con't)

A cloud is a mass of tiny droplets which are too lightweight to fall through the air currents. When, by grouping together, the droplets reach a size large and heavy enough to fall without evaporating again before they hit the earth, they may fall as raindrops. In very cold upper air, the vapor closes together and becomes ice crystals, which fall as snowflakes.

In any event, raindrops leave their cloud and fall. In falling, they may take a shape as long and thin as a hot dog or as round and flat as a pancake. They may even be shaped like a dumbbell. Of course, not all the drops fall back into the ocean, for the clouds may have been carried many miles away by wind and air currents. Where the raindrops fall on the land, they may run together and course down mountainsides as streams. The streams become rivers that carve deeper and deeper river beds on their way to sea.

Water Cycle Questions

Answer the following questions by filling in the missing word or words.

- 1) Almost _____ of the earth's surface is water.
- 2) The process of _____ takes place when water changes to vapor.
- 3) _____ happens when the vapor turns back into droplets of water.
- 4) The vapor rising from the ocean is moved around by _____ and _____ currents.
- 5) When a cloud is carried into colder areas _____ will begin to form.
- 6) A cloud is a mass of tiny _____ of water which we call vapor.
- 7) In very cold upper air, vapor sometimes moves extremely close together and becomes _____.

ANSWER SHEET
WATER CYCLE QUESTIONS

1. ALL
2. EVAPORATION
3. CONDENSATION
4. WIND/AIR
5. RAINDROPS
6. DROPLETS
7. ICE CRYSTALS

77

Lesson II

What Is Pollution?

Objective:

Students will write a one sentence definition of pollution which includes the components: 1) matter 2) added to nature (environment) 3) unwanted by someone.

Materials:

two glasses
water
small amount of dipstick
oil
floor sweepings
film (see listing) on
water pollution
1 student response sheet:
"What Is Water Pollution?" (pg. 49)



Introduction: Although your students may have some experience with the term pollution, this media presentation may be the first formal presentation on the subject of water pollution. The lesson provides an overview of the subject. The student should be helped to understand the major aspects of water pollution and its effect on human life.

Four films available for loan from the Alaska State Library are suggested for viewing. Each film presents a different perspective on the same problem and emphasizes different forms of pollution. If these films are unavailable for loan when you need them, there is an alternative way of presenting this lesson. In the grades 1-3 section of these curriculum materials, lesson II, you will find visuals and discussion questions which will help develop a definition of pollution. The visuals may be reproduced for either individual handouts or for use on an overhead projector.

The emphasis of the following three lessons is on organic pollutants - micro-organisms such as algae, bacteria, and protozoa. The focus on microscopic organisms will help raise interest in the relationship of water pollution to human health.

Suggested Films, Water Pollution

13048 Water Pollution -
Encourages student concern about the abuse of natural resources, tracing the causes and results of water

pollution. Shows how clear water becomes contaminated and useless as garbage, sewage, insecticides and industrial wastes flow into rivers, lakes and streams. Points out that science alone cannot fight the battle against pollution.

34733 Drop By Drop To The Sea -
Examines ocean contamination and pollution. Depicts the ocean environment, flora and fauna and the effects of pollution.

33347 House of Man, Pt. 1 - Our Changing Environment -
Discusses the waste of natural resources in cities, woodlands and farmlands, and the pollution of rivers and the air. Compares the 'progress' achieved through wasteful methods and through intelligent conservation techniques. Shows how man's intelligence can be channeled to plan for progress.

30028 Clean Water -
Portrays the importance of natural waters. Illustrates the danger of pollution to fish and wildlife, city water systems, recreational facilities and public health. Proper sewage treatment for preventing this pollution is explained by animated diagrams.

Vocabulary

Preparation: pollution

Instructional

Activities:

1. Hold up a glass of clean water and a glass of water which has had a few drops of oil and floor sweepings added. Which would they like to drink? Which is probably bad for your health? Tell the students that this is the subject of the next few units. They will learn more about how polluted water is bad for their health and how people make water safe for drinking.
2. Write "pollution" on the board and ask what the word is. What does it mean? List student responses on the board. Tell the class that they will return to the question after viewing a film about pollution.
3. Screen the film selected from the State Library list.

(optional) - If a film is unavailable, or if more reinforcement is needed, use the pamphlet "For the Health of Your Family ... Is Your Drinking Water Safe?" This booklet, available from the Department of Environmental Conservation in Juneau, provides a good overview of Alaska's drinking water problems. The transparencies contained in the unit for grades 1-3 can also be used for an introduction.

4. Hand out "What Is Water Pollution?" worksheet and allow time for the students to write and/or draw in their answers.
5. Using student response, compile a class definition of water pollution.

Suggested definition: Anything added to nature in big enough amounts to be unwanted by someone.

WHAT IS WATER POLLUTION ?

From the information on water pollution which you have seen, complete the questions below by writing your answer in each box. If you have your own ideas, write them in also.

1. How does water become polluted?

2. How can you get sick from pollution?

3. What are some of the bad things in water that might hurt you?

4. How is water made safe?

5. Write your definition of pollution.

Objective:

Students will be able to, after viewing and sketching samples of water-borne micro-organisms, produce a rough sketch of an organism and write the name of the organisms, to the teacher's satisfaction.

**Materials:**

microscope(s)
slides of protozoa
algae
bacteria
glass of algae-filled water
1 overhead transparency:
"The Cycle of a Disease-Causing Micro-organism"
(pg. 53)
1 student reading material: "Water-Borne Diseases"
(pg. 52)
2 student response sheets: "Disease Report" (pg. 54)
"Slide Response Sheet" (pg. 55)

Introduction:

The threat of an epidemic outbreak of water-borne disease is real in Alaska. Documented cases of outbreaks from Barrow to Ketchikan are available from the Alaska Department of Environmental Conservation. The list of infectious diseases carried by Alaskan surface waters includes typhoid, dysentery, hepatitis, giardiasis and others. Unprotected and untreated surface waters are always vulnerable to unpredictable contamination by man, animals or carrion-eating birds.

This lesson teaches about water-borne diseases and micro-organisms to support the need for safe drinking water.

Before class, collect the slides and arrange the microscopes into viewing stations. Allow space for students to draw pictures of the specimens. Space the stations for easy movement between them.

Vocabulary**Preparation:**

bacteria
microscope
parasite

protozoa
micro-organisms
larva

algae
disease

**Instructional
Activities:**

1. Before the viewing activity, tell the class that they will see three kinds of tiny life forms which, when taken into the body, can

cause serious illness. Many people get sick each year in Alaska because of unsafe drinking water. This sickness is carried by micro-organisms - germs - of many kinds, causing different illnesses.

2. Allow all the students to have a look at each slide through the microscope. Tell the students that later in the lesson they will return and make drawings of what they see.
3. Preface the disease life cycle presentation by asking how illness is spread. The children will likely have many ideas on this subject. Lead into the concept of water-borne diseases.
4. Put up "The Cycle of a Disease-Causing Micro-Organism" transparency. Using the information in the reading "Water-Borne Diseases", read or paraphrase the cycle of the dog tapeworm. Respond to questions as they arise. The transparency provides a visual reference and a focus for explanation.
5. Show the glass of water containing algae. Point out which microscope has the algae slide. Tell the class that algae itself does not cause disease, but can cause a bad taste and odor in water and means that the water has been standing and is possibly unsafe. Where have you seen this kind of water, what time of year? (Point out that algae grows in standing water in sunny places and is often seen in Alaskan waters in late summer.)
6. Allow time for the students to view the algae and protozoa slide specimens and sketch them on the response sheet.

Additional
Activities:

1. Using the "Disease Report" handout, assign students, individually or by groups, a disease to be reported on from encyclopedia books.

Water-Borne Diseases

adapted from: Assessment of Alveolar Hydatid Disease
In Alaska (U.S. Environmental Protection Agency)

Tapeworms are parasites - animals which live on or inside other animals. Dog tapeworms are found in dogs, sheep, moose, wolf, caribou and people. The tapeworm is caught from polluted water or right from the dirty ground. Here is how that can happen.

Starting at the middle of the drawing we see a fox. It can be a red fox, arctic fox, a wolf, or a dog. The tapeworm lives in the intestines of the fox (wolf, or dog). You would not be able to tell easily if your dog had a tapeworm - he would not appear sick because the tapeworm parasite is normal for many animals like dogs. The tapeworm lays eggs which pass out with the dog's droppings - or the fox's. The eggs are in a hard shell and there are about 200 tiny eggs in each shell. Animals which do have tapeworm spread many eggs in their droppings for several months at a stretch.

When passed in the droppings, the eggs may be spread over nearby soil and plants. They may also be picked up and spread by wind and water.

Next you can see two kinds of animals that may pick up the eggs from the ground, droppings or water which has run over them. Normally the eggs are picked up by mouse-like animals called lemmings. Inside the lemming the shell breaks open and the growing tapeworm enters the animal's blood.

What animal eats lemmings? The fox, wolf, and dog eat lemmings and therefore end up with the tapeworms.

This is called a life cycle. You see that the tapeworm goes in a circle from one fox, wolf, or dog through the ground or water to the lemming to a fox, dog, or wolf again.

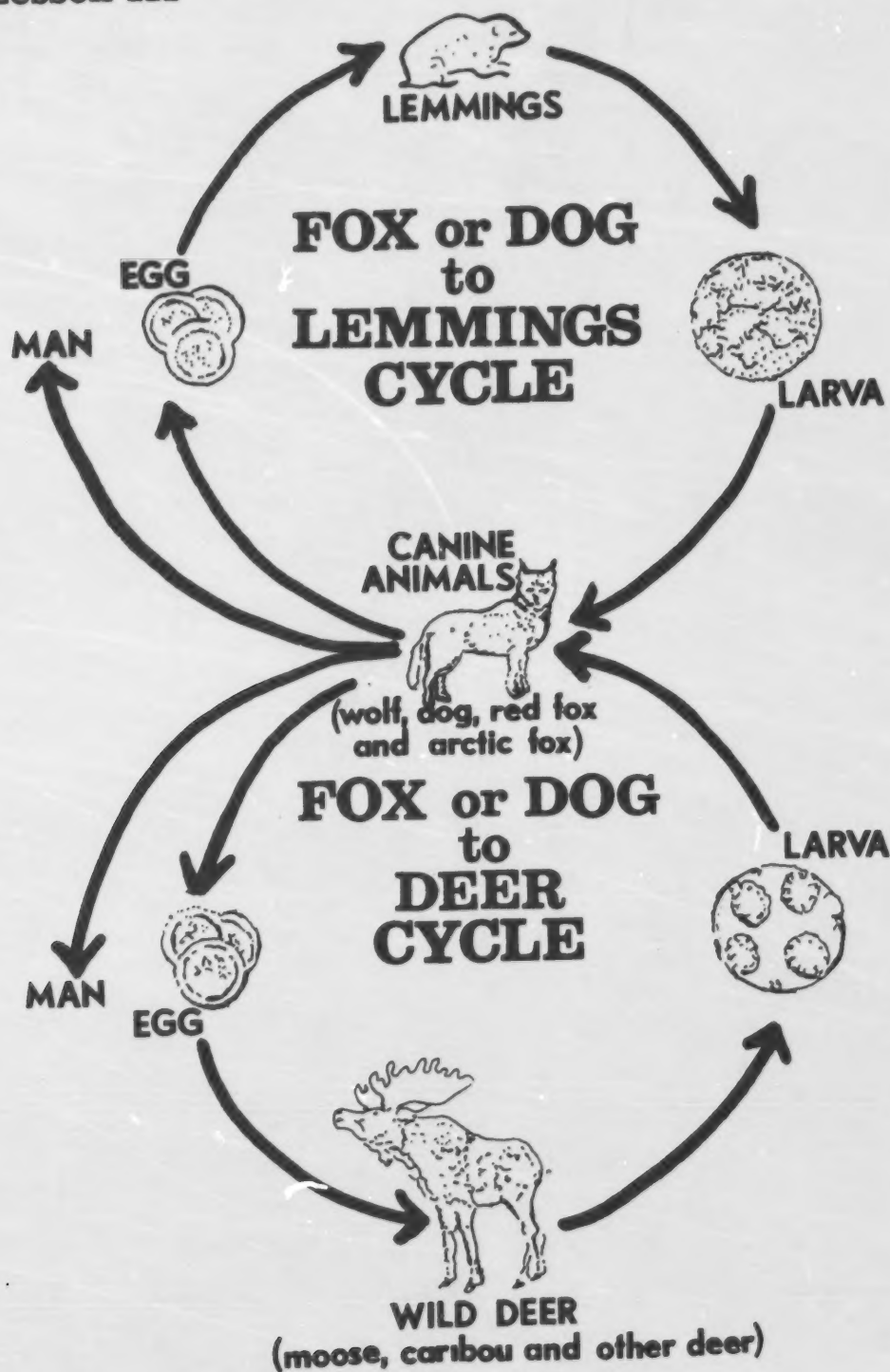
But look over here after the fox or dog passes the egg-filled shell with its droppings. What other animal could pick up the tapeworm from the ground or the water running over it?

People can pick up the tapeworm from dogs. Children play with the dogs and in places where there are dog droppings. Eggs may be carried into the house on shoes or on the dog's fur.

What might happen if people drink water that has run over ground having droppings from infected animals?

The Cycle of a Disease-Causing Microorganism (Tapeworm) (UE #3)

4-6 Lesson III



The life cycles of two species of *Echinococcus*, demonstrating host relationships as they occur naturally in North America.

DISEASE REPORT

The threat and potential threat to safe drinking water in Alaska comes from various sources. Each pollutant, in the right amount and under the right conditions, will cause illness and disease in human beings. These diseases can all be caused by pollution of drinking water:

- Typhoid
- Cholera
- Dysentery
- Infectious Hepatitis
- Diarrhea
- Salmonella
- Gastroenteritis
- Tapeworm

Use an encyclopedia to read about one of these diseases and write a short report on the health problems.

ALGAE

4-6 Lesson III

Slide Response Sheet

Contaminated water supplies directly affect health, causing such water-borne illnesses as infectious hepatitis, shigellosis, diarrhea, and such skin infections as impetigo. There is a high incidence of these diseases in rural Alaska. When safe water is difficult to obtain in a community, health is also affected, as adequate clean supplies are necessary for personal and household hygiene: oral hygiene, treatment of minor cuts and bruises, food preparation, clothing and personal hygiene.

Draw one picture from each of the **two** categories of microorganisms.

PROTOZOA

Objective:

Students will view a demonstration of the effectiveness of water treatment, and will explain at least three of the four steps in the chlorination demonstration with accuracy.



Materials:

three glasses
packet of baker's yeast
household bleach
(do not allow the students to see the bleach bottle)
two tablespoons syrup (Karo, etc.)
teaspoon
1 student reading material: Southeast Alaska Empire
article (pp. 58-59)

Introduction:

Carefully transfer a few drops of bleach to a small container labeled POISON before the experiment. Do not identify the chlorine as to its source as household bleach.

This lesson will show the effects of chlorine on micro-organisms. It will take approximately two hours to show clear results. The experiment can be started easily during a convenient point in the morning and then set aside for examination later during the day. This simple experiment will give the children a concrete reference for further instruction in water treatment.

Many water supplies are treated with chlorine, a liquid which has been used to destroy disease organisms in town water supplies since 1897. It works by forming a powerful oxidizing agent which burns up the organic material in the water. This makes the water safer, also changing the color, taste and odor.

Vocabulary

Preparation:

Salmonella
prohibits
preventatives
ingested
provision

disinfection
confirmed
chlorination
feces
diarrhea

investigation
adequate
requirements
hygiene

Instructional
Activities:

1. Explain to the class that they will see an experiment in which the micro-organisms they have studied will be eliminated from water. Explain this process will be done in two periods - first growing the organisms and later destroying them by using a chemical called chlorine.

Lesson IV

Water Treatment (con't)

2. The experiment begins by adding 1/2 teaspoon of dried bakers' yeast to 1/2 glass of warm water. This should be done a half hour prior to the period and redone for demonstration purposes for the students.
3. Separate the mixture into two clean glasses. To one glass add five drops of laundry bleach. Add 1 teaspoon of syrup (yeast will ferment the sugar - producing alcohol and carbon dioxide which feed the micro-organisms) to each glass and stir gently. Set the glasses aside for later examination, marking them for identification.
4. To begin the afternoon period tell the students that you will read a newspaper article adapted from The Southeast Alaska Empire by Ines Edicott, written sometime during the summer of 1974, which reports on a water-borne disease which affected a number of people in Juneau.
5. Say that we will now look at what the chlorine mentioned in the article really does to micro-organisms.

The glass with the chlorine added should show no activity, while the glass free from chlorine should have activity caused by the growing yeast. (The chlorine killed the yeast exactly like it kills the bacteria, algae, and protozoans in the water which might cause sickness.)

6. Develop a list of pollution sources on the chalkboard. Help the students recognize any identifiable threats to their water source.

Southeast Alaska Empire - Article
by Ines Edicott

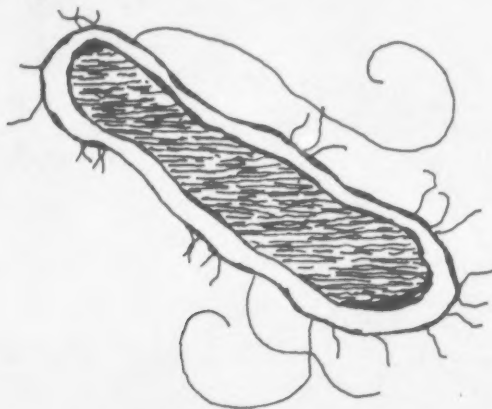
The Department of Environmental Conservation yesterday issued its first emergency order, charging a danger exists to those people served by the Switzer Creek water supply.

Last week the water supply was determined to be the probable cause of an outbreak of salmonella.

The department charged that "lack of adequate disinfection has existed in spite of repeated requests from local and state health authorities. On July 23rd from 5 p.m. to 6:30 p.m., an investigation by representatives of the Department of Environmental Conservation showed totally absent or not enough chlorination in the water system".

According to the order, the water must maintain an adequate level of chlorine throughout the water supply. The order further prohibits new connections to the public water supply until state requirements are met.

Twenty-three cases of salmonella infection were confirmed here last week by the public health lab.



Salmonellosis is a serious infectious disease with symptoms of stomach ache, diarrhea, nausea, vomiting and fever. The organism is spread by being ingested in food or water that has been infected by the feces of animal or man.

To be safe, the Division of Public Health recommends:

- good personal hygiene through hand washing after using toilet facilities;

- keeping infected persons from food handling or the care of young children.
- the provision of safe, adequate food and water supplies;
- persons having symptoms of diarrhea or fever lasting more than 24 hours should see their doctor or contact the Public Health Office.

Lesson V

Water Plant Visit

Objective:

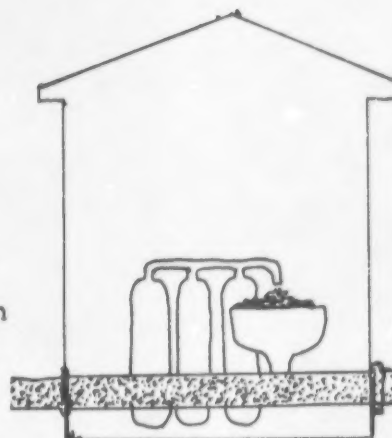
Following a visit to a local water treatment facility, students will complete a fact-finding worksheet with an accuracy of at least six of the ten items.

Materials:

Visiting arrangements, including transportation to and from local water treatment facility

1 visual aid: "How Water Treatment Facilities Work" (pg. 62)

1 Suggestions sheet for Fact-Finding Worksheet (pg. 63)



Introduction:

This lesson provides a concrete reference for the concepts of water pollution and safe drinking water which have been introduced. The students should be prepared before their visit. Develop a set of questions to ask during the visit.

Have advanced contact with the person who will be conducting the tour. Explain the purpose of the visit and the student goal of completing a fact-finding worksheet.

Different communities will have water plants of varied sophistication. Many Alaskan facilities do not chlorinate the water at all, relying instead on maintaining a source and distribution system free of contamination. Learn for yourself in advance of your visit how the local system functions so that you can establish a focus for the students' field experience.

Small villages may have a system as simple as a water pump and tank trucks for carrying lake or stream water to homes. In others, the school may have the only water system. Here, the maintenance person could explain how the water recycling works and how contamination of drinking water is avoided.

Included here is a visual "How Water Treatment Facilities Work" which provides background information for the teacher. In addition, it may be used following (or in place of) the water plant visit to reinforce and clarify what was seen.

If your community has a more elaborate system - desalination, recycling, etc., some time should

Lesson V

Water Plant Visit (con't)

be spent with the facility's supervisor to learn the essentials of its operation.

Instructional Activities:

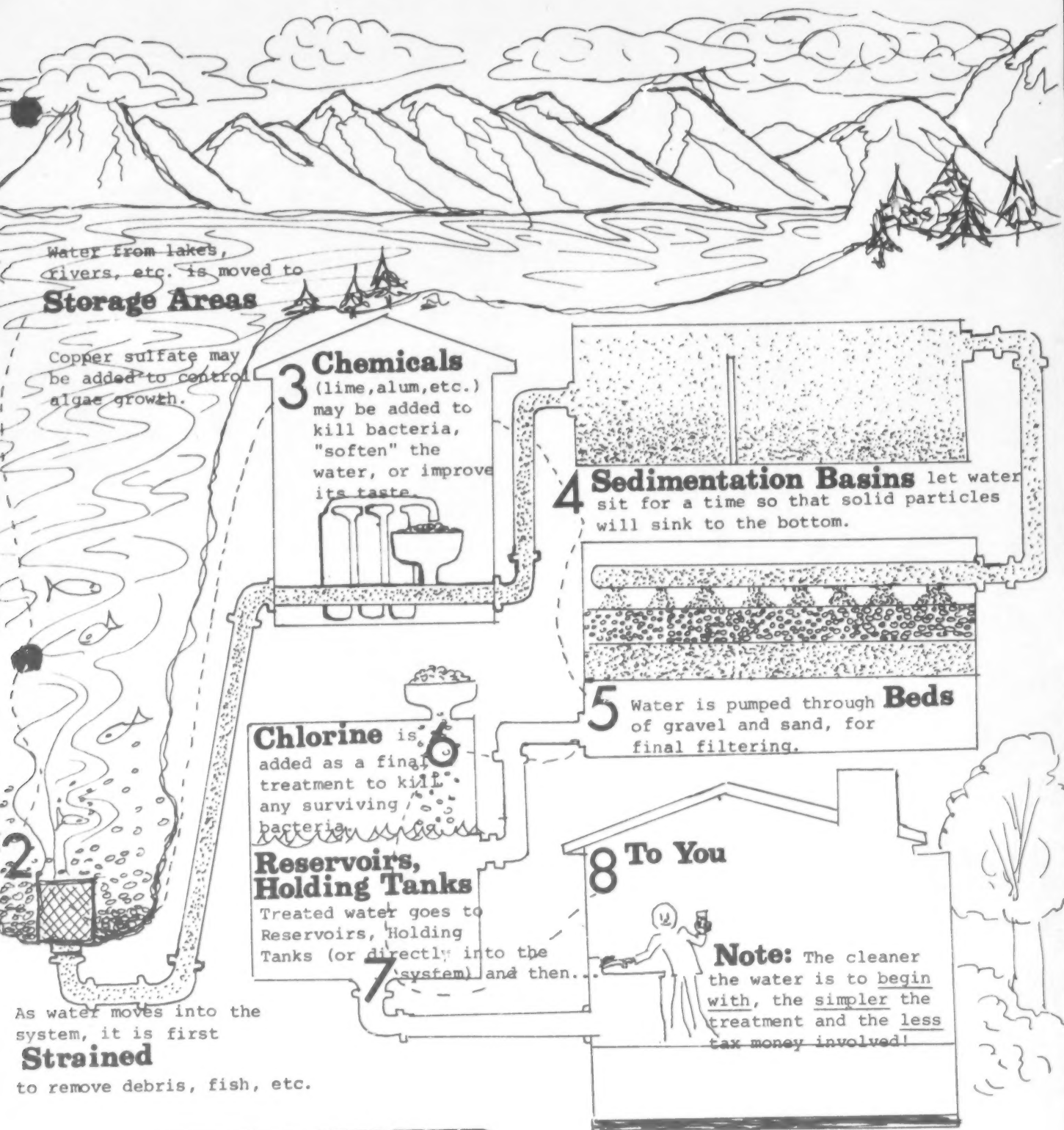
1. Assess the students' knowledge of the local water supply in preparation for the visit. (This will generate involvement and provide a focus for the emphasis to be placed during the tour.)
 - A. How does water get to your house?
 - B. Where does your water come from?
 - C. What kind of people bring it to you (who works there)?
2. Make a list of students' questions on the chalkboard. Here are some starters to lead the class into forming useful questions:
 - A. Are there any problems with pollution and the local water supply?
 - B. Is the water tested? How often? By whom? What is it tested for?
 - C. Is chlorine used in treatment? Is anything else added?
 - D. Have there ever been any outbreaks of disease locally that might have been caused by water problems?

Make a list of the class questions to be duplicated and given to each student to record the answers either during the visit or after returning to the classroom.

3. Make the visit to the treatment facility. Be alert for opportunities to highlight those aspects of the tour applicable to the questions raised by the class and the essentials of the "Water Treatment Facilities" information sheet.
4. Following the visit, duplicate and distribute the fact-finding worksheet for the students to complete and hand in.

Additional Activities:

1. Write a story about a hero/heroine who saves the day for a town or group of people who have a danger in their drinking water.
2. Make a list of things which a) individual persons, b) families, c) towns, can do to make sure their drinking water is safe.



HOW WATER TREATMENT FACILITIES WORK

Suggestions for Fact-Finding Worksheet

1. List and/or draw the steps in the water treatment process. This could account for a majority of the ten points in the worksheet. For example, a typical facility would have 1) storage areas; 2) strainers; 3) chemical adders (softeners); 4) sediment basins; 5) chlorine adders; 6) holding tanks.
2. List two or more jobs that you saw being done at the water plant.
3. List two unwanted things which can be found in water?
4. List two things which are added to water to improve it (taste, color, hardness, safety).

CURRICULUM FEEDBACK FORM

Unit used _____	Grade Level _____	Name _____
Age Level _____	# of Children _____	Address _____
Type of Group (school class, scouts, etc.) _____		_____
_____		_____
Approx. hours spent on unit _____		_____
Comments _____		_____
_____		_____
_____		_____
_____		_____

1. Background information was: Just what I needed I needed more unnecessary
2. How many follow-through suggestions were used?
3. Instructions were easy to follow? yes _____ no _____
4. Children were interested? _____
5. Suggested discussion questions worked well? _____
6. I will use this unit again _____
7. I used other grade-level units to supplement the one for my group's age _____

Please describe below any adaptations you made or improvements you suggest:

Please mail this form to the address listed on the back, and
THANK YOU VERY MUCH FOR YOUR HELP!

fold

(Stamp)

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